East Coast Floridan Model

Overview and Results

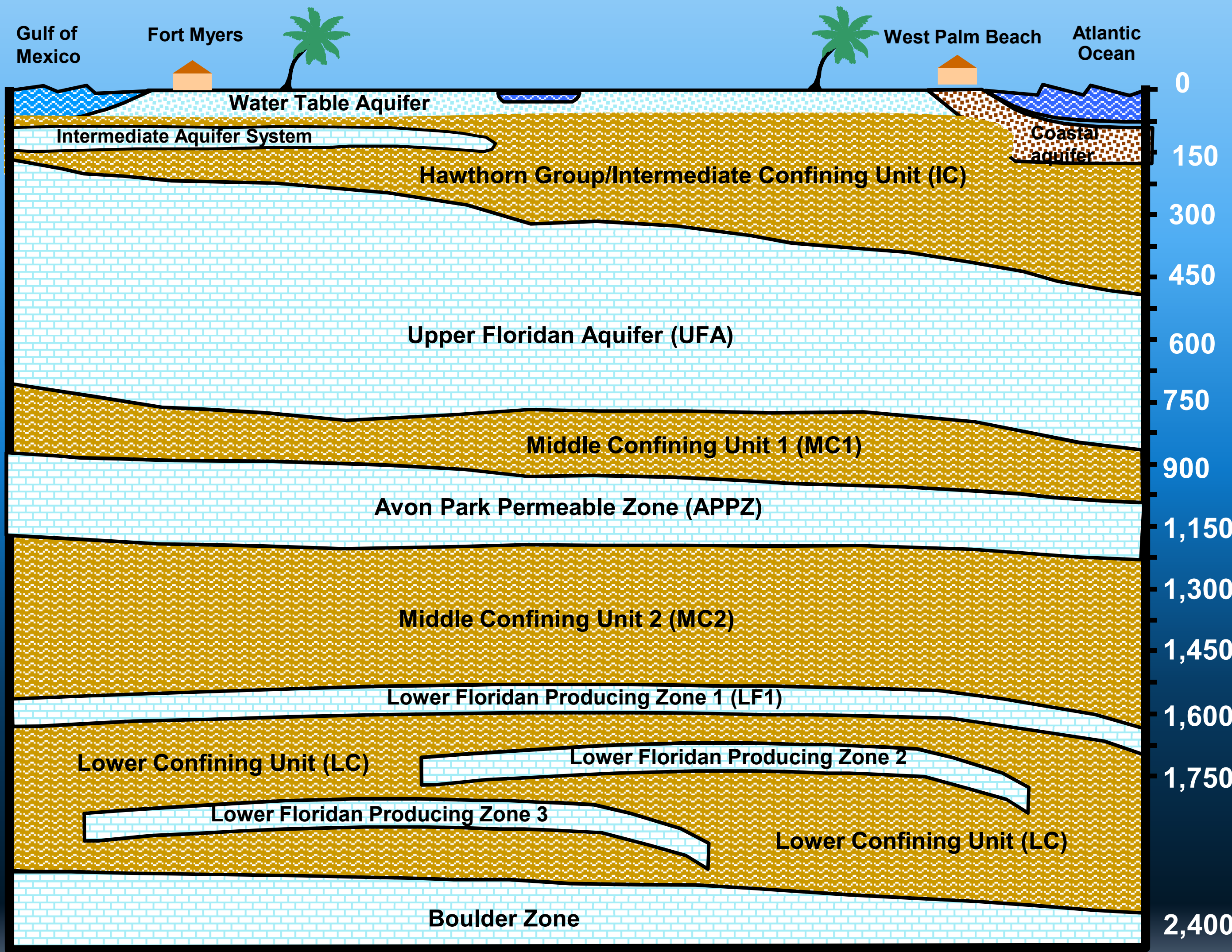
Lower East Coast Planning Region

Peter J. Kwiatkowski, P.G.
Section Administrator, Water Supply Bureau, SFWMD
August 22, 2018

LEC Floridan Aquifer System Modeling

- Application of the East Coast Floridan Model (ECFM) in support of the 2018 Lower East Coast Water Supply Plan Update
- ECFM was used in 2016 Upper East Coast WSP Update
- ECFM was peer reviewed and comments incorporated
- Two simulations
  - 2016 Current Condition (using actual FAS withdrawals for 24 years)
  - 2040 Future Condition (using projected FAS withdrawals for 24 years)
- Key measurements: water levels, water quality, flows

ECFM Layers



East Coast Floridan Model Layers

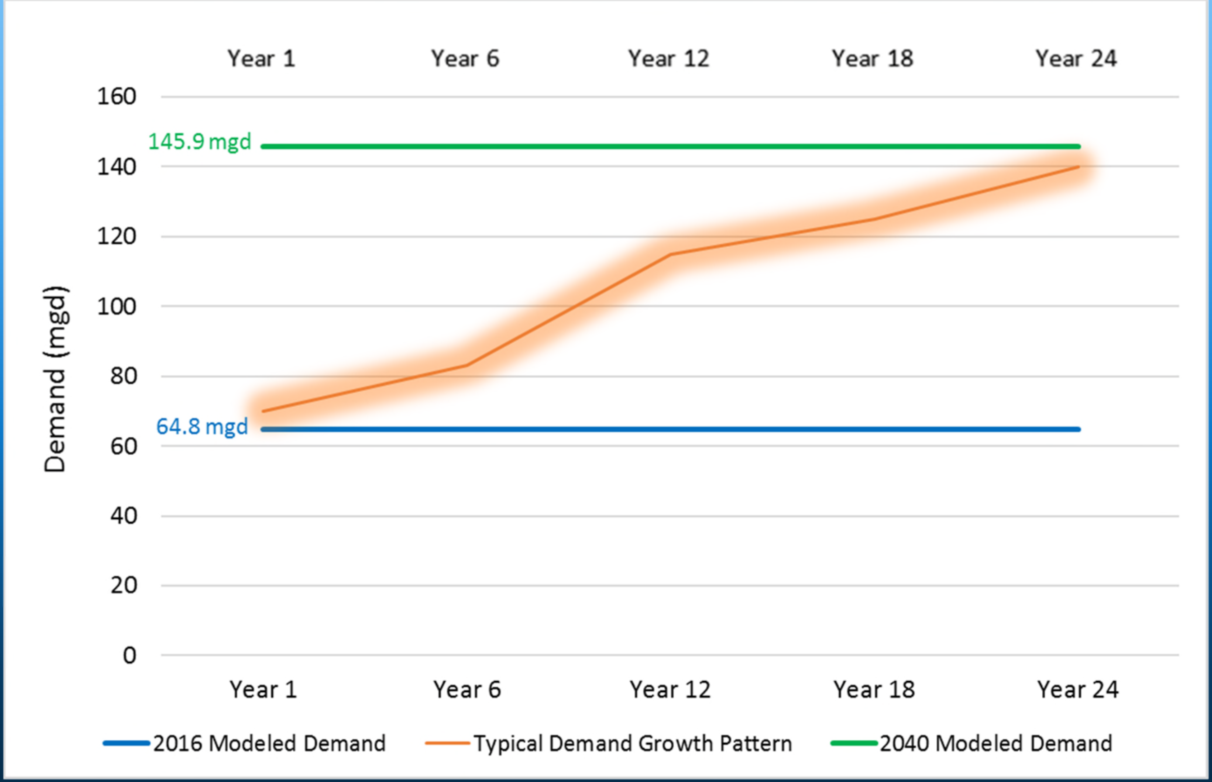
- Layer 1
- Layer 2
- Layer 3
- Layer 4
- Layer 5
- Layer 6
- Layer 7

Key Assumptions

- 2016 Run used actual pumped volumes
- 2040 Run used projected demands
  - Typically less than permitted volumes
  - FAS used only after SAS allocation maximized
  - Existing FAS wells used first; proposed wells used if necessary
  - Historical use patterns were considered
- ASR wells not simulated

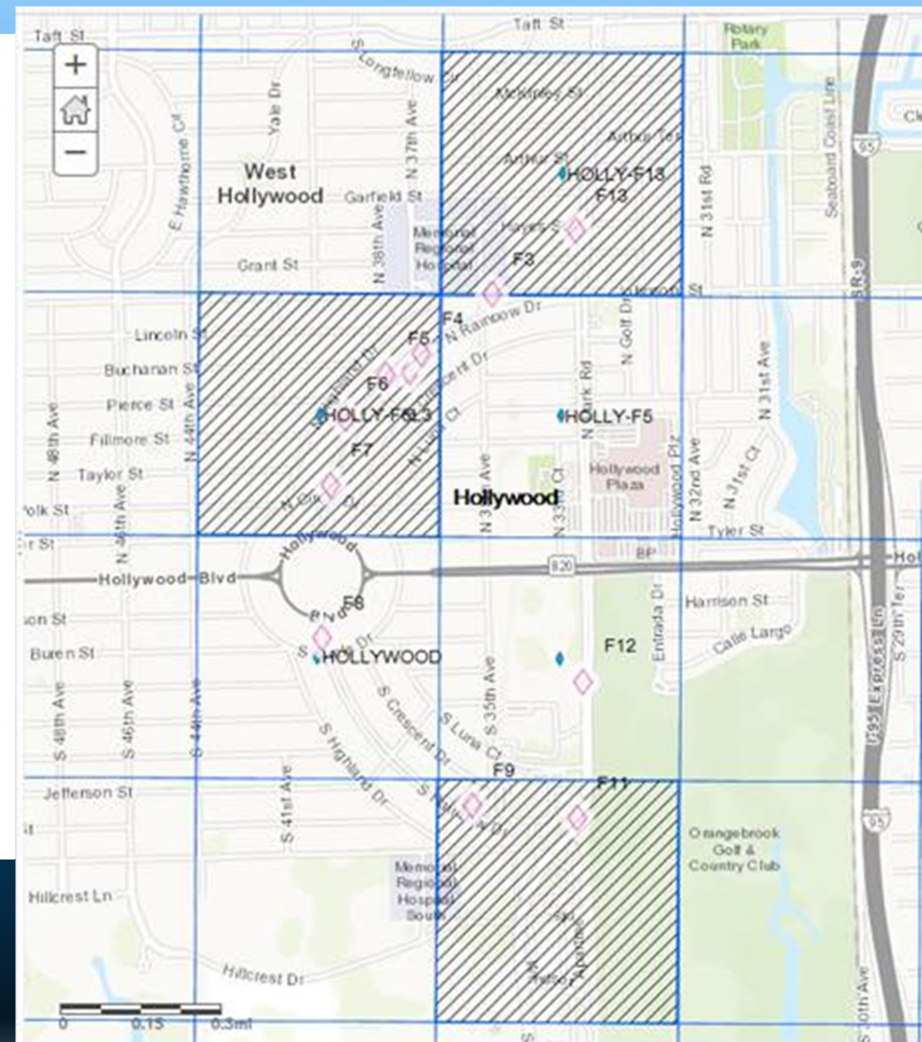
Limitations in Simulating Demands

- Each simulation is 24 years
  - Same as calibration period
  - Wide range of climatic conditions
- Can't simulate annual demand growth
- Simulated demands are "instant on"
- Results from the 2040 simulation are considered conservative



Regional Model Limitations

- Model Cell: 2,400 feet by 2,400 feet
- Multiple wells in a single model cell
- Model aggregates all withdrawals at center of model cell
- Tends to exaggerate water level drawdowns and water quality degradation
- Results are conservative



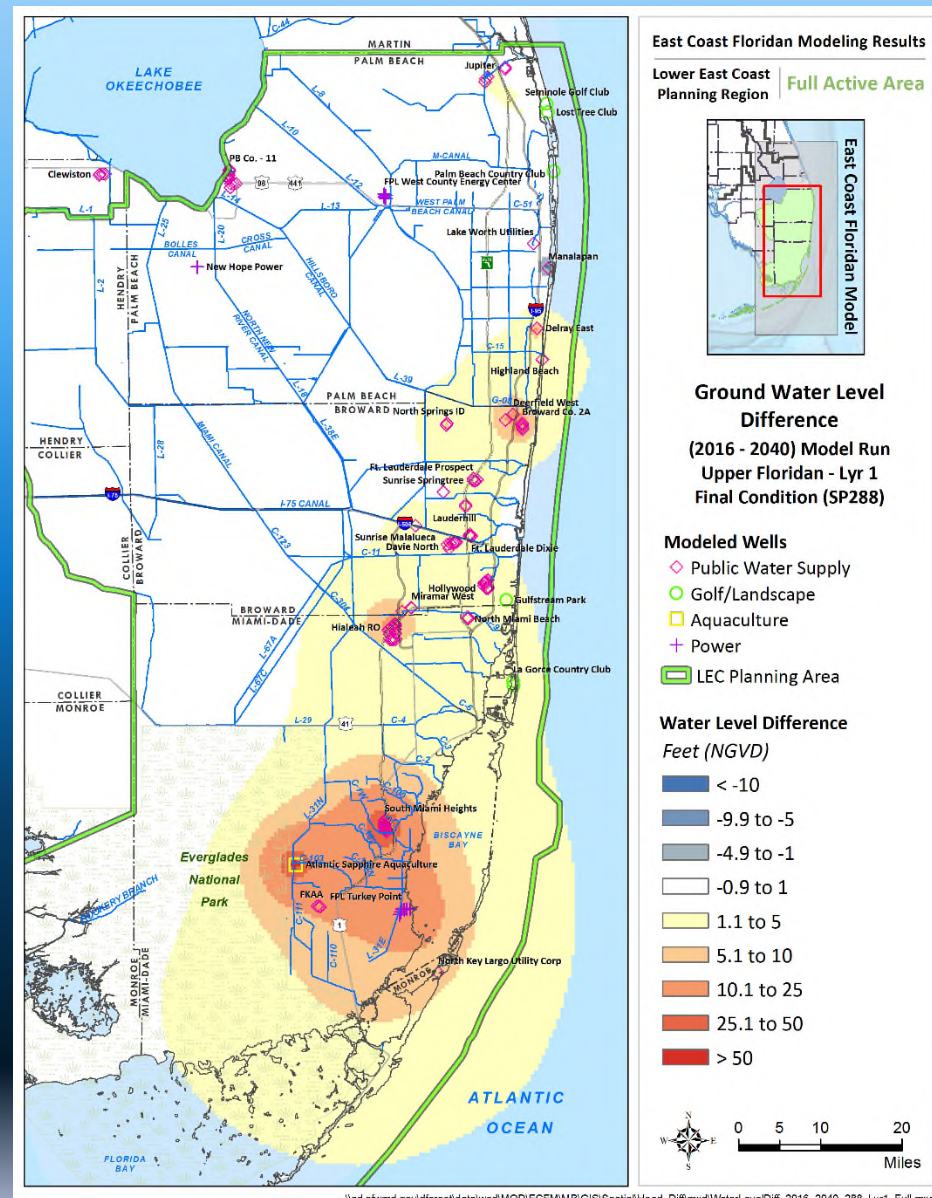
LEC Floridan Aquifer System Demand Summary by County

County	FAS Allocation (mgd)	2016 FAS Modeled (mgd)	2040 FAS Modeled (mgd)
Palm Beach	48.81	29.48	34.92
Broward	56.54	12.74	29.02
Miami-Dade	102.34	22.26	81.66
Monroe*	3.82	0.36	0.38
Total	**211.51**	**64.84**	**145.98**

* Wells for FKAA, the primary water supplier in Monroe County, are located in Miami-Dade County.

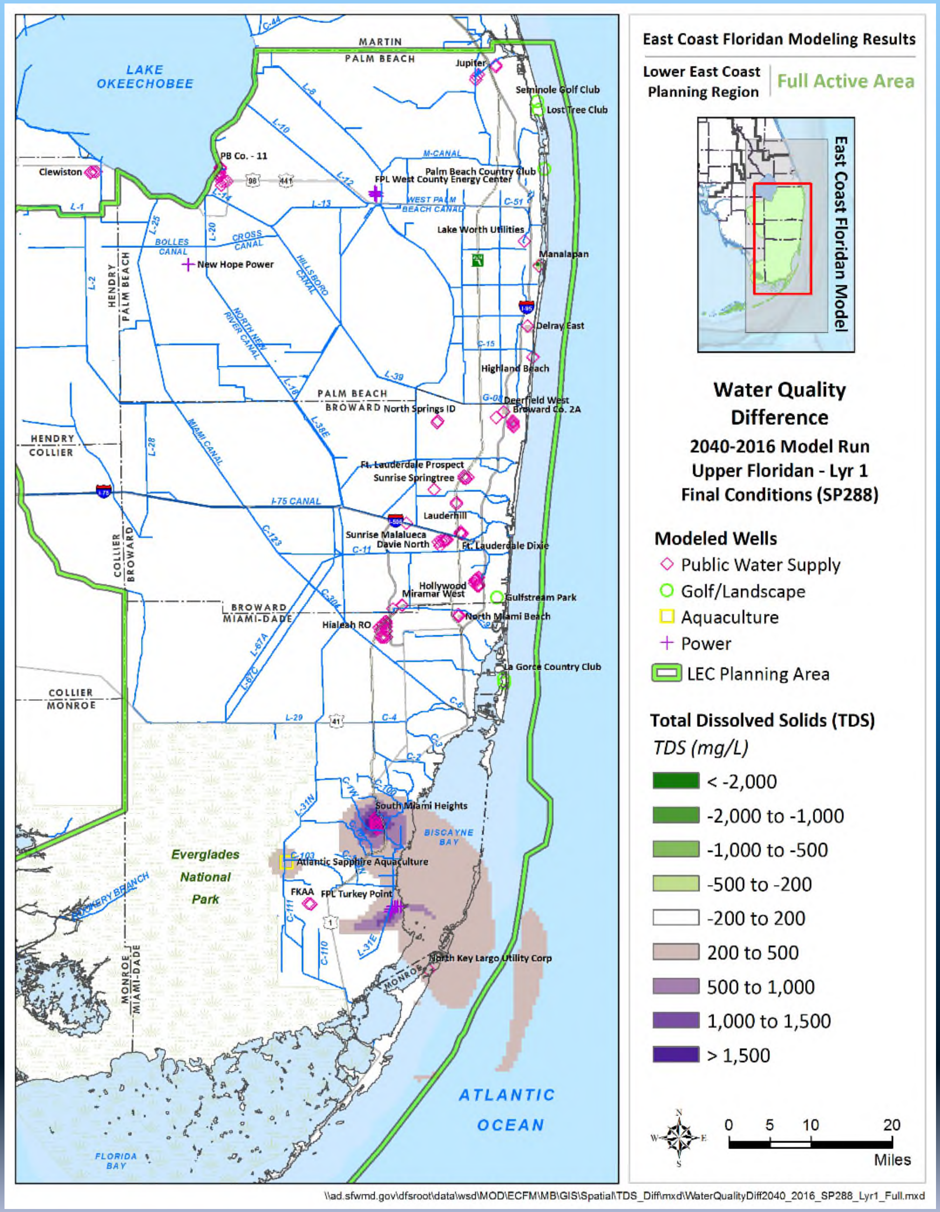
Water Level Differences

- Model run: 2040-2016
- Layer 1
- Stress period: 288
- Existing & proposed wells shown
- Change in potentiometric surface
- In feet NGVD
- Range: -10 ft to above 50 ft
  - Negative values reflect increased water levels



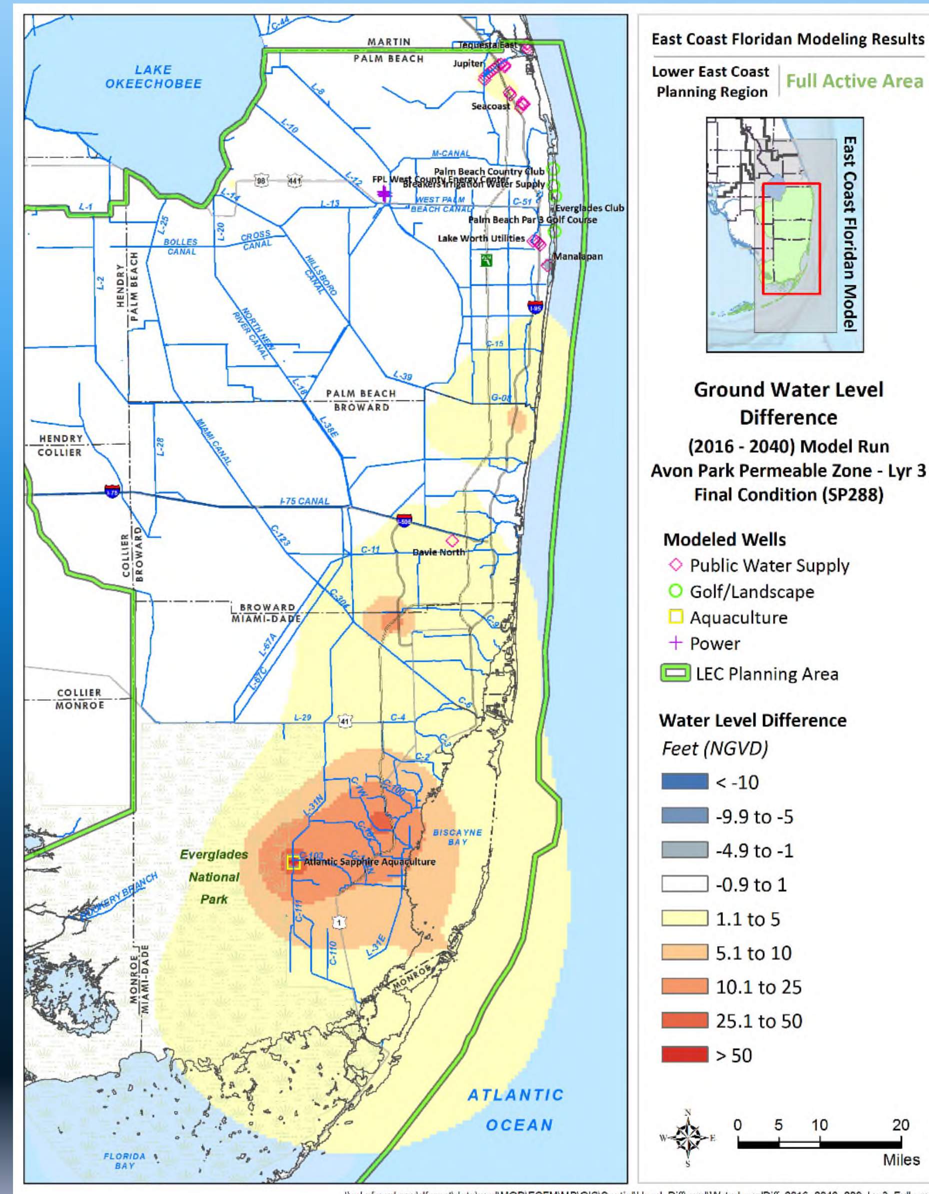
Water Quality Differences

- Model run: 2040-2016
- Layer 1
- Stress period: 288
- Existing & proposed wells shown
- TDS in mg/L
- Range: >-2,000 to >1,500



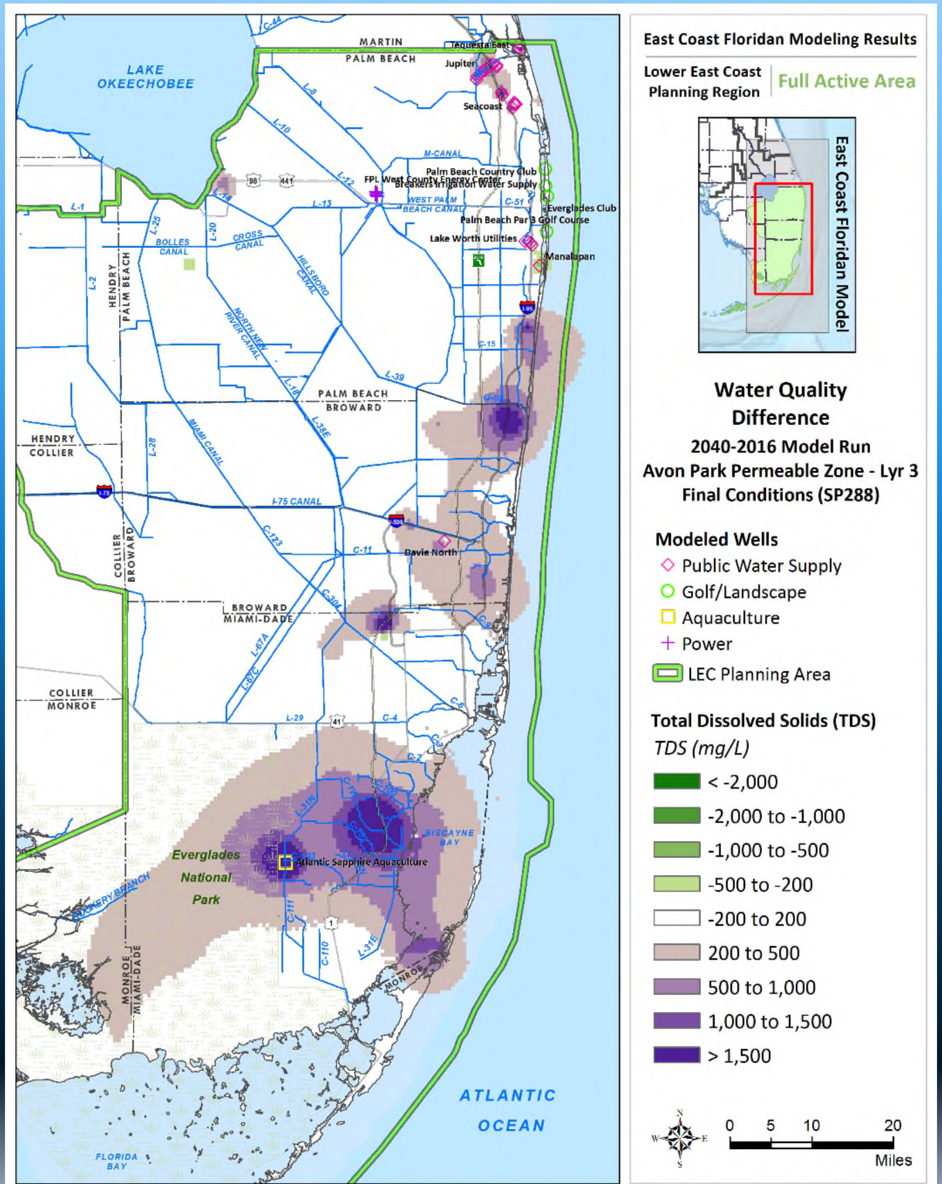
Water Level Differences

- Model run: 2040-2016
- Layer 3
- Stress period: 288
- Existing & proposed wells shown
- Change in potentiometric surface
- In feet NGVD
- Range: <-10 ft to >50 ft



Water Quality Differences

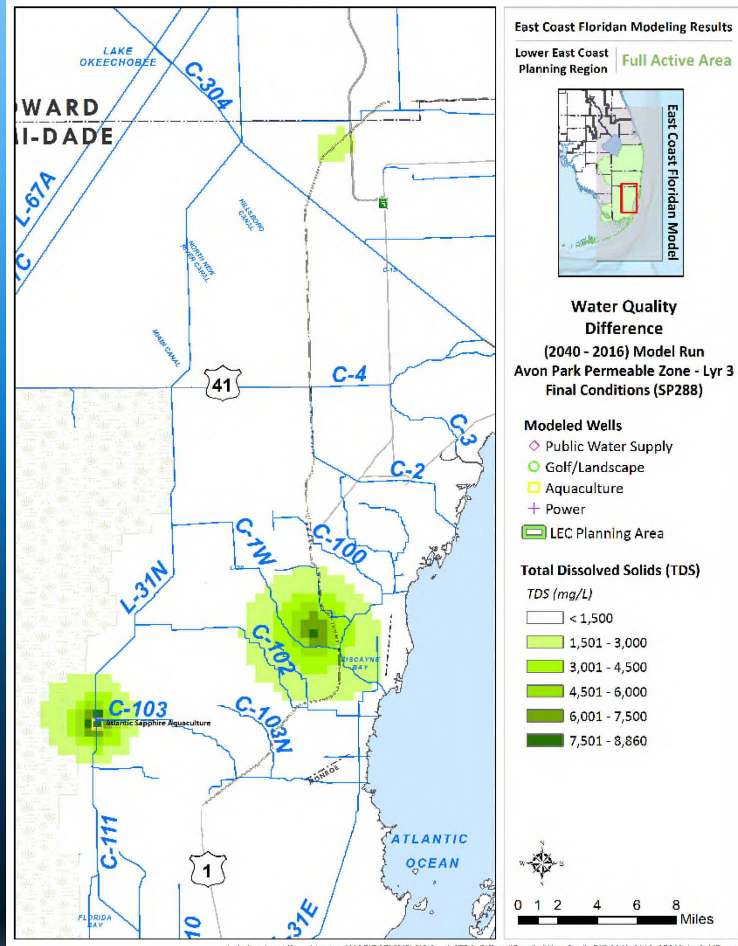
- Model run: 2040-2016
- Layer 3
- Stress period: 288
- Existing & proposed wells shown
- TDS in mg/L
- Range: <-2,000 to >1,500



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Water Quality Differences Miami-Dade Close Up

- Model run: 2040-2016
- **Layer 3**
- Stress period: 288
- Existing & proposed wells shown
- TDS in mg/L
- Range: 1,500 to 8,860



Observations

- Water Level
  - Stages in APPZ (Layer 3) decline in vicinity of some Upper Floridan aquifer (Layer 1) withdrawals, suggesting upward movement of water
- Water Quality
  - Some degradation occurs, although much of the change is <1,500 mg/L TDS over 24 years
  - Potential upward movement of APPZ water into Upper Floridan aquifer may degrade water quality
- Regional Model
  - May not be able to simulate response at individual wells
- FAS appears to be capable of meeting projected demands of all users as simulated through 2040

Next Steps

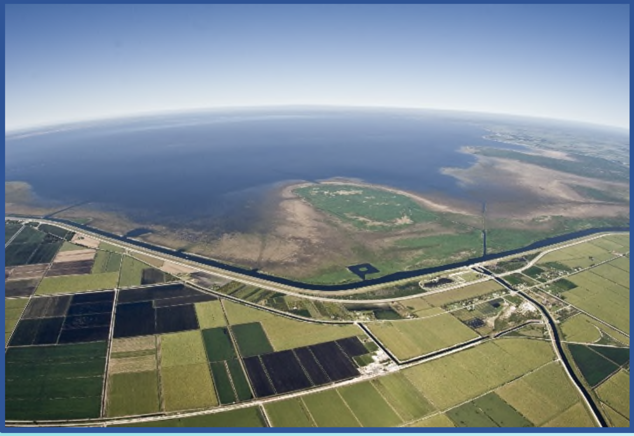
- Improve sustainability of the FAS to meet water needs:
  - Increase coordination with PWS utilities
  - Encourage conservative wellfield design and operation
    - Additional wells with greater spacing between them
    - Reduced pumping from each well to minimize upconing of poor-quality water.
    - Lower pumping rates from APPZ wells to minimize upconing of poor-quality water.
  - Work with utilities to obtain refined wellfield operational plans and communicate these refinements to the SFWMD for possible incorporation into future ECFM efforts.
  - Gather additional well construction, aquifer test, lithologic, and other data from new and existing FAS wells from utilities and other FAS users for inclusion in update of ECFM – *Thank you to those who have already done so!*

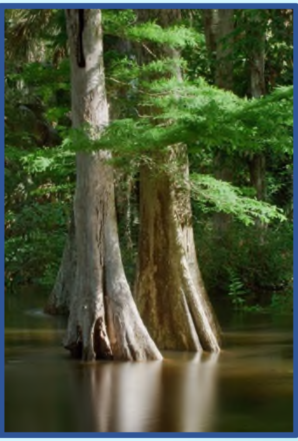
Next Steps (cont'd)

- Evaluate the potential for water quality changes and its effect on other regulatory programs (e.g., Underground Injection Control)
- Evaluate the issue of water quality degradation from one existing legal user to another from a regulatory perspective

Thank you

2018 Lower East Coast Water Supply Plan Update



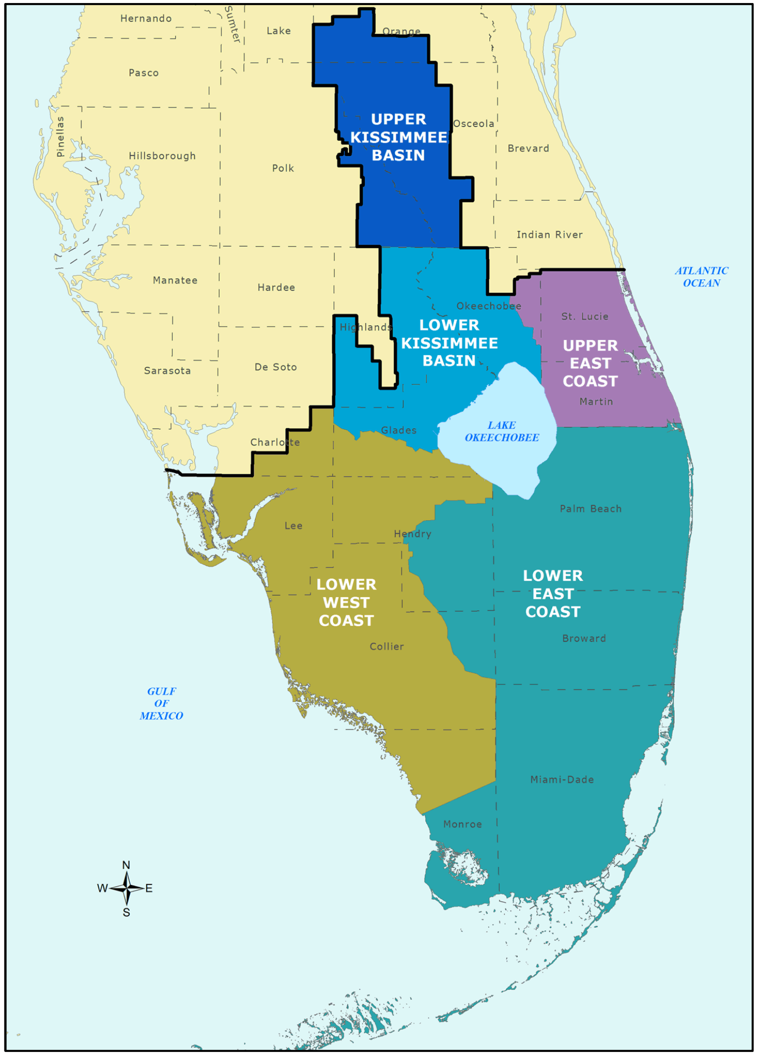



Karin Smith, P.G., Plan Manager
Mark Elsner, P.E., Bureau Chief

Stakeholder Workshop #3
August 22, 2018

Water Supply Plan Requirements

- 20-year planning period
- Demand estimates and projections
- Resource analyses
- Issues identification
- Evaluation of water source options
- Water resource development
  - Responsibility of water management
- Water supply development
  - Responsibility of water users
- Minimum Flows and Minimum Water Levels
  - Recovery and prevention strategies

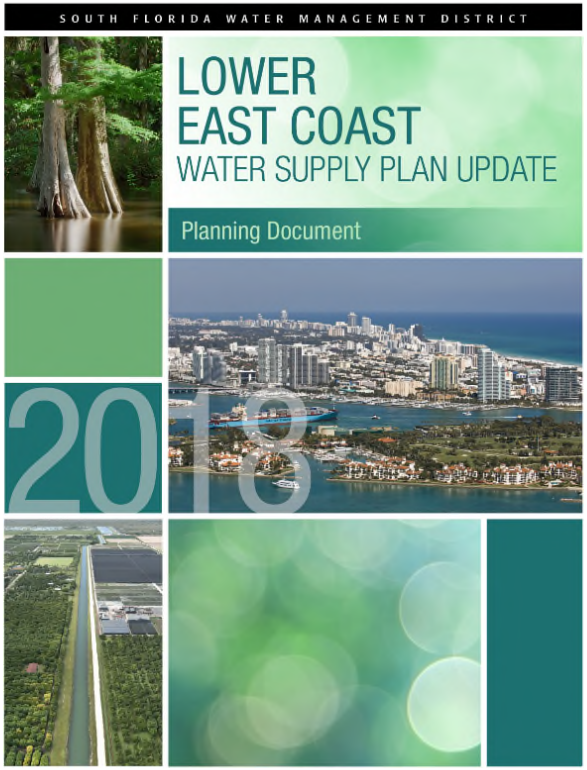


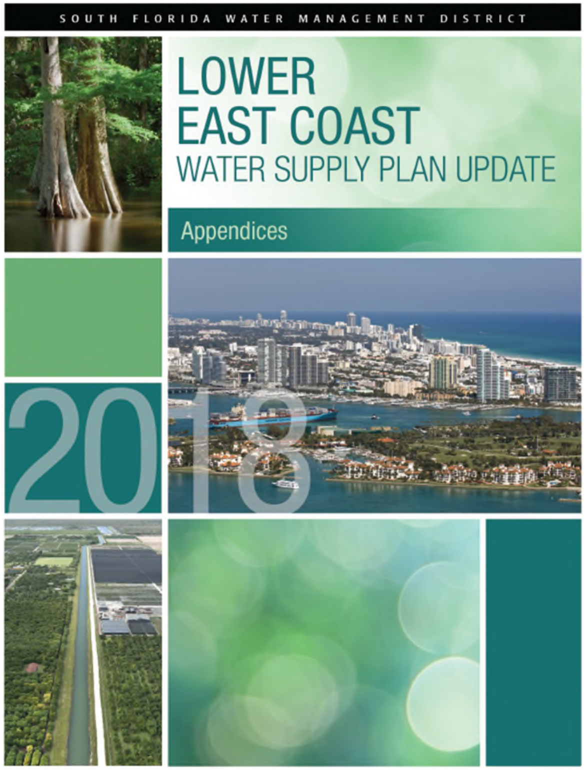
Information Sources

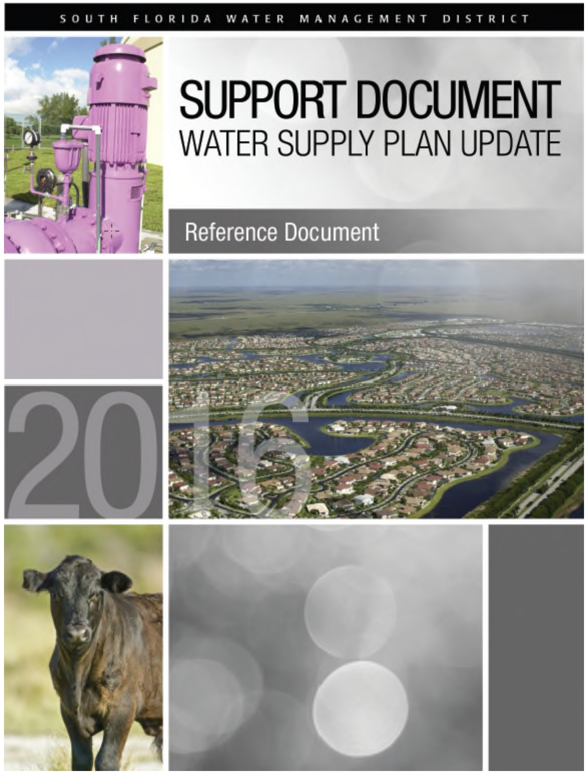


2018 Lower East Coast Water Supply Plan Update Documents

Planning Document | **Appendices** | **Support**







Planning Document Outline

Executive Summary

Chapter 1: Introduction ✓

- Plan goal and objectives, Planning Area overview, climate change & sea level rise, progress since 2013 Plan

Chapter 2: Demand Estimates and Projections

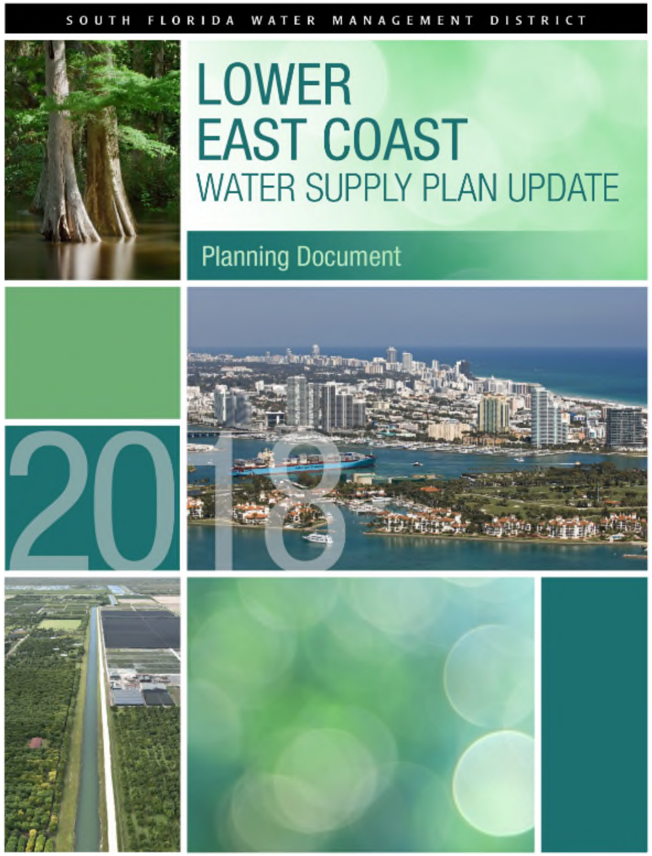
- Population and demands by water use type

Chapter 3: Demand Management: Water Conservation ✓

- Conservation effects on current & future demand

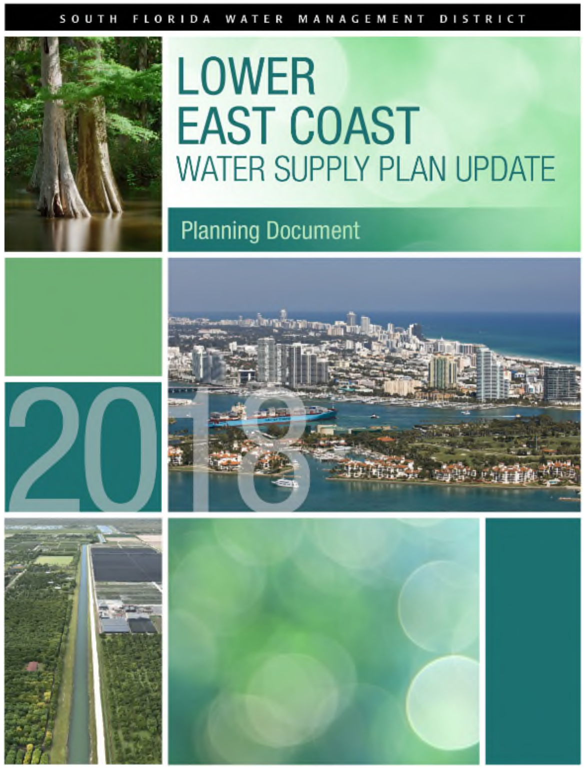
Chapter 4: Water Resource Protection ✓

- Regulatory protection, permitting, MFLs, Water Reservations, Restricted Allocation Areas, and monitoring



✓ Indicates portions of document sent for early external review

Planning Document Outline cont.



Chapter 5: Surface Water Resources and Management ✓

- Surface water for natural systems, surface water management in 4 sub-areas

Chapter 6: Water Resource Development Projects

- Ecosystem restoration, CERP, modeling, monitoring

Chapter 7: Water Supply Source Options

- Surface water, groundwater, reclaimed, storage, seawater for urban & agricultural needs

Chapter 8: Water Supply Development Projects

- PWS Projects to meet demands through 2040

Chapter 9: Future Direction

- Water sources, coordination, climate change

Appendices Document

A: Information for Local Governments ✓

- Comp Plan guidance, Utility/City crosswalk, 2016 & 2040 service area maps

B: Water Demand Projections

- Methodologies and detailed results

C: MFLs and Recovery & Prevention Strategies ✓

D: Groundwater Monitoring and Analysis

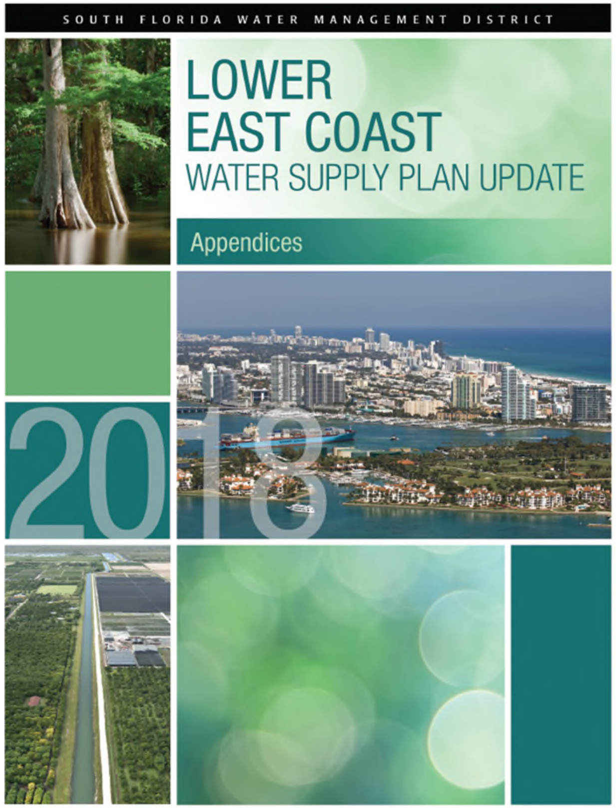
- ECFM model results, water levels, MDL & water quality monitoring, saltwater interface maps, PWS FAS quality trends

E: Public Water Supply Utility Summaries

- Wellfield maps, demands, permit info, projects

F: Wastewater Treatment Facilities ✓

- Maps, profiles, reclaimed volumes and end users



Goal of Water Supply Plans

To identify sufficient water supply sources and future projects to meet existing and future reasonable-beneficial uses during 1-in-10 year drought conditions through 2040 while sustaining water resources and related natural systems.



Objectives of this Plan Update

- Identify water supplies
- Increase water conservation & alternative water source development
- Protect & enhance natural systems
- Ensure compatibility and linkage with other efforts
- Provide linkage with local governments





Regional & Local Planning Linkage

After plan update approval:

- Local governments have 18 months to amend their Comp Plan to incorporate a Water Supply Facilities Work Plan (*by May 2020*)
- Utilities identify the projects to be developed
- Utility annual progress reports
  - Due in November
  - District on-line WaSUP database

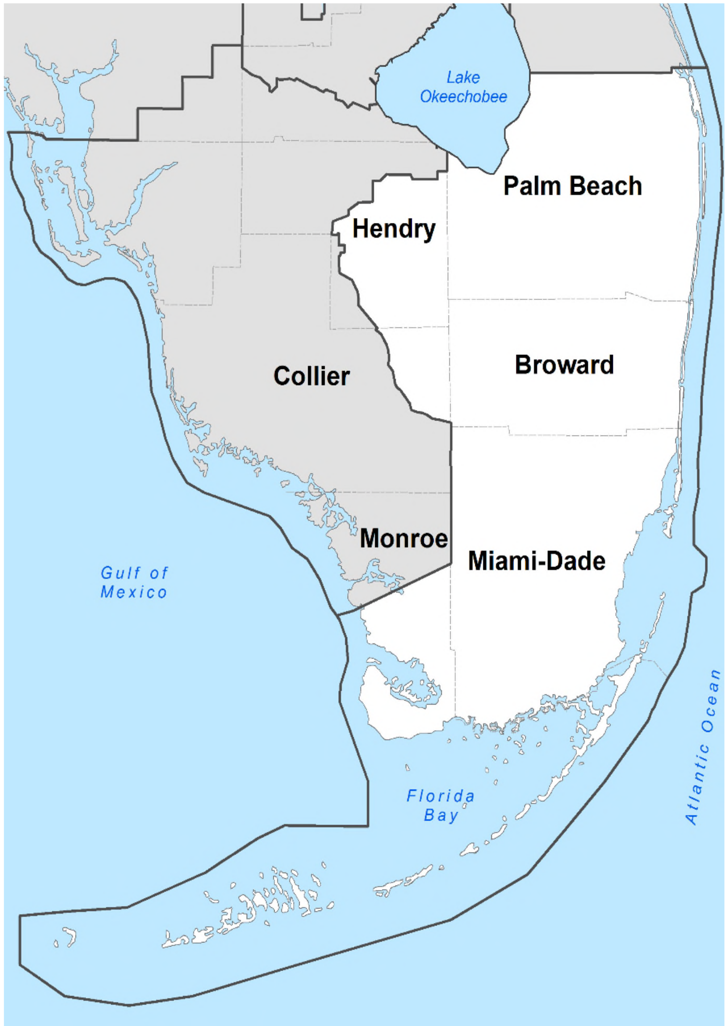


Sea Level Rise & Climate Change

- South Florida is particularly vulnerable
- Rate of sea level rise predicted to accelerate
- SFWMD is preparing by:
  - Conducting research
  - Computer modeling
  - Analyzing vulnerabilities in the current water management system
  - Developing adaptation strategies
- Quarterly updates to Governing Board
- Coordinate with others, including Climate Change Compact

SOUTHEAST FLORIDA REGIONAL COMPACT CLIMATE CHANGE

Lower East Coast Planning Area



Planning Horizon 2016-2040

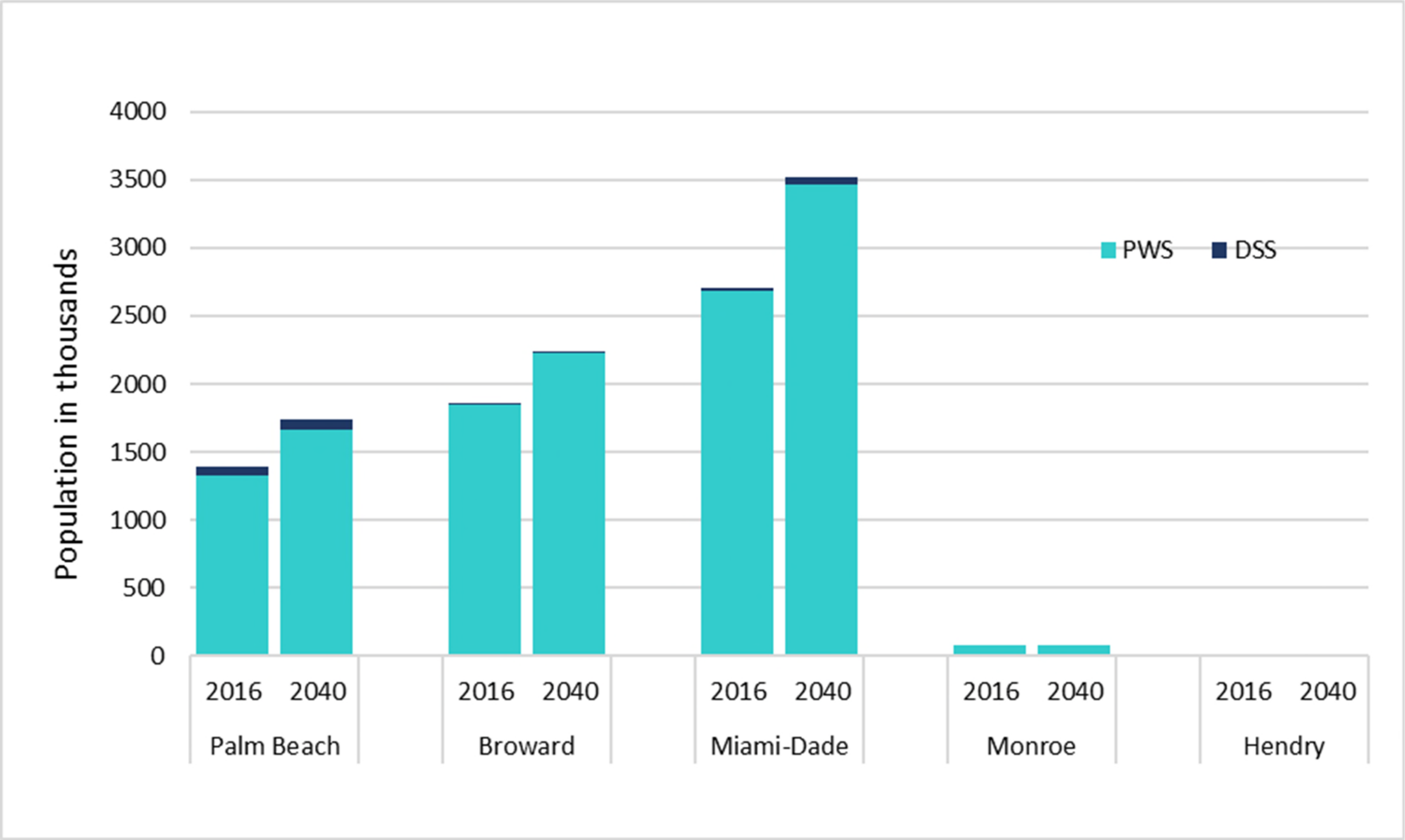
- Population:
  - 2016 6,027,190
  - 2040 7,570,351

  26% increase
- Irrigated agricultural acreage:
  - 2016 581,470
  - 2040 550,080

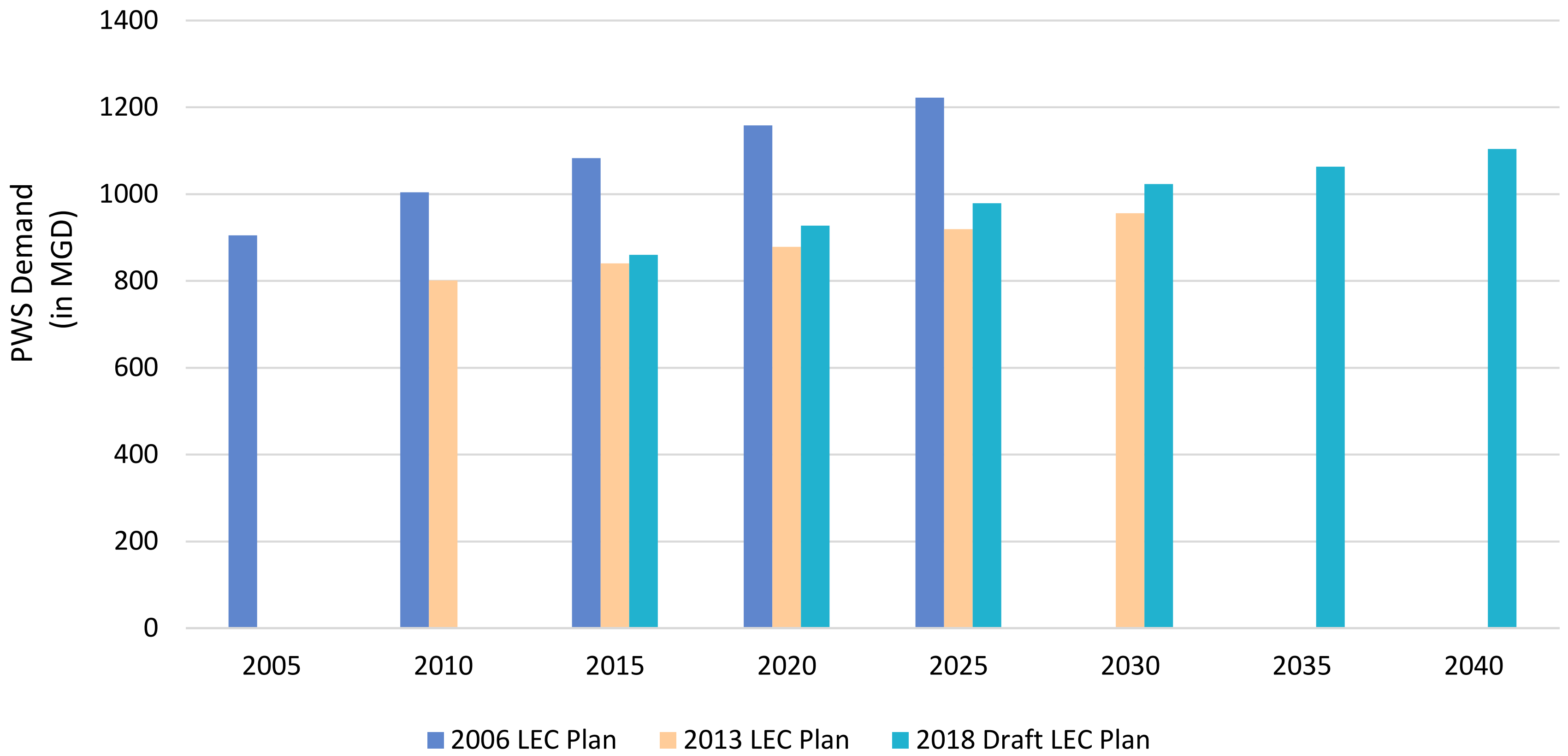
  5% decrease
- Gross water demands:
  - 2016 1,757 mgd
  - 2040 2,005 mgd

  14% increase

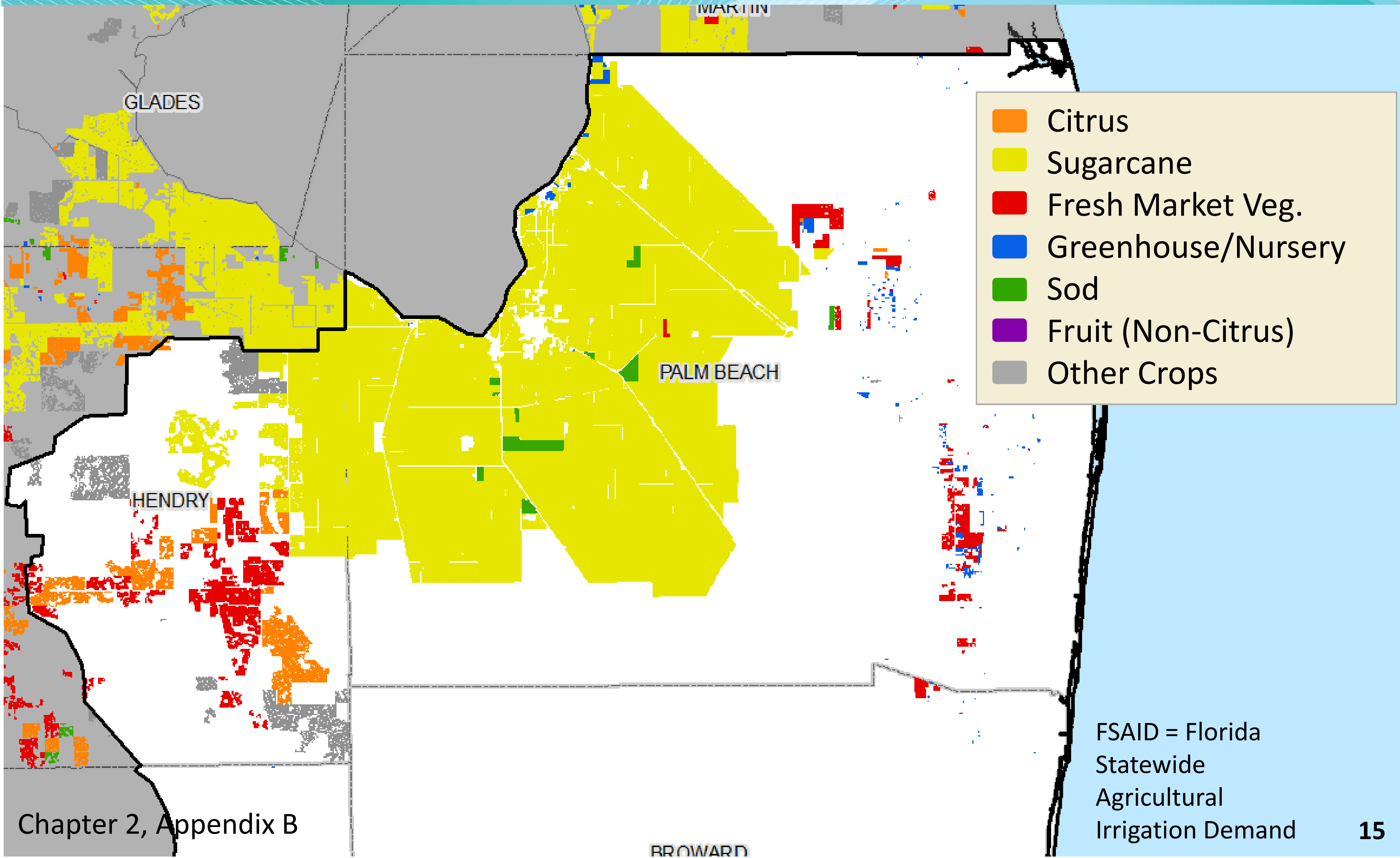
Population Projections



History of PWS Projected Demands

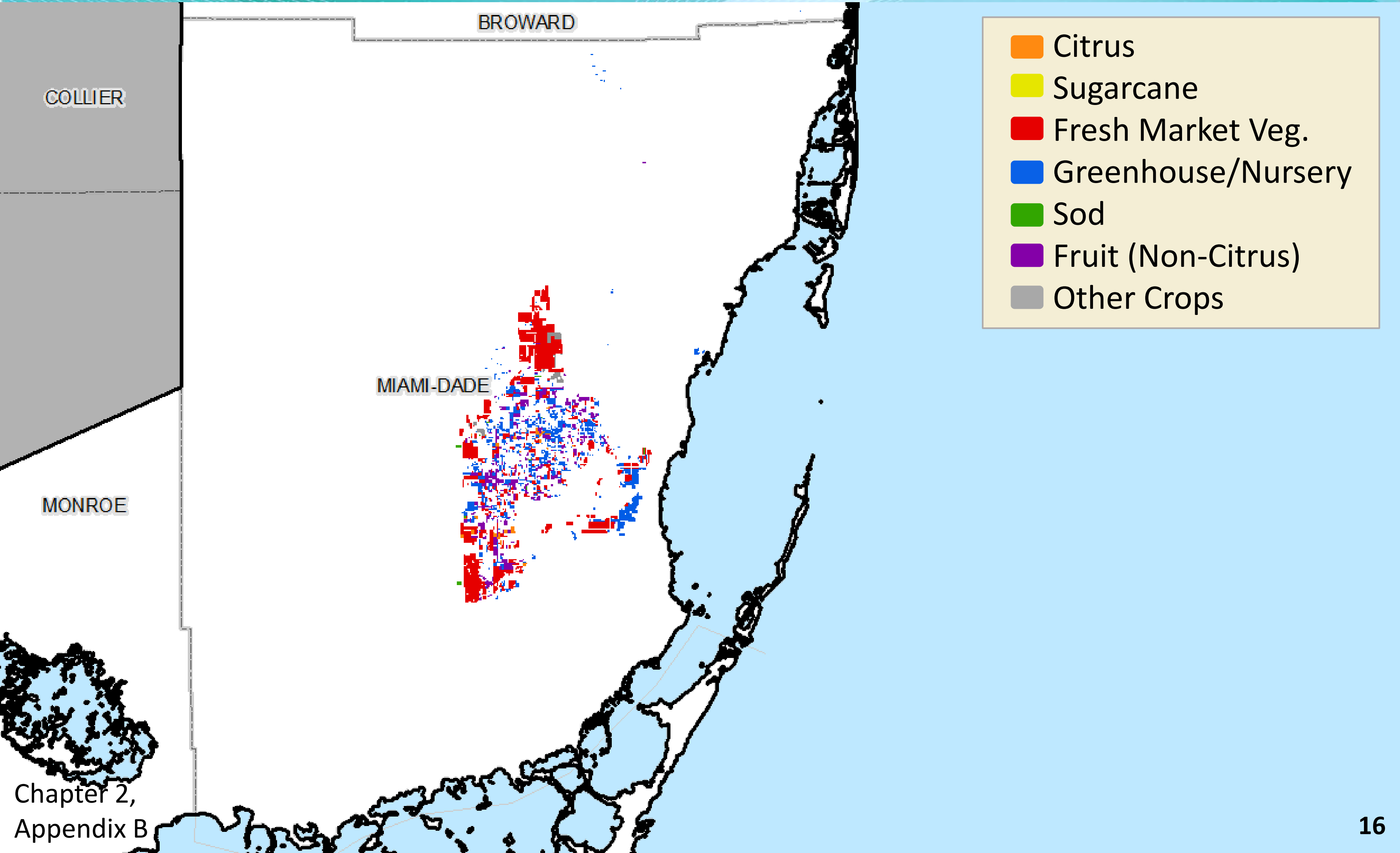


2016 FSAID Irrigated Areas

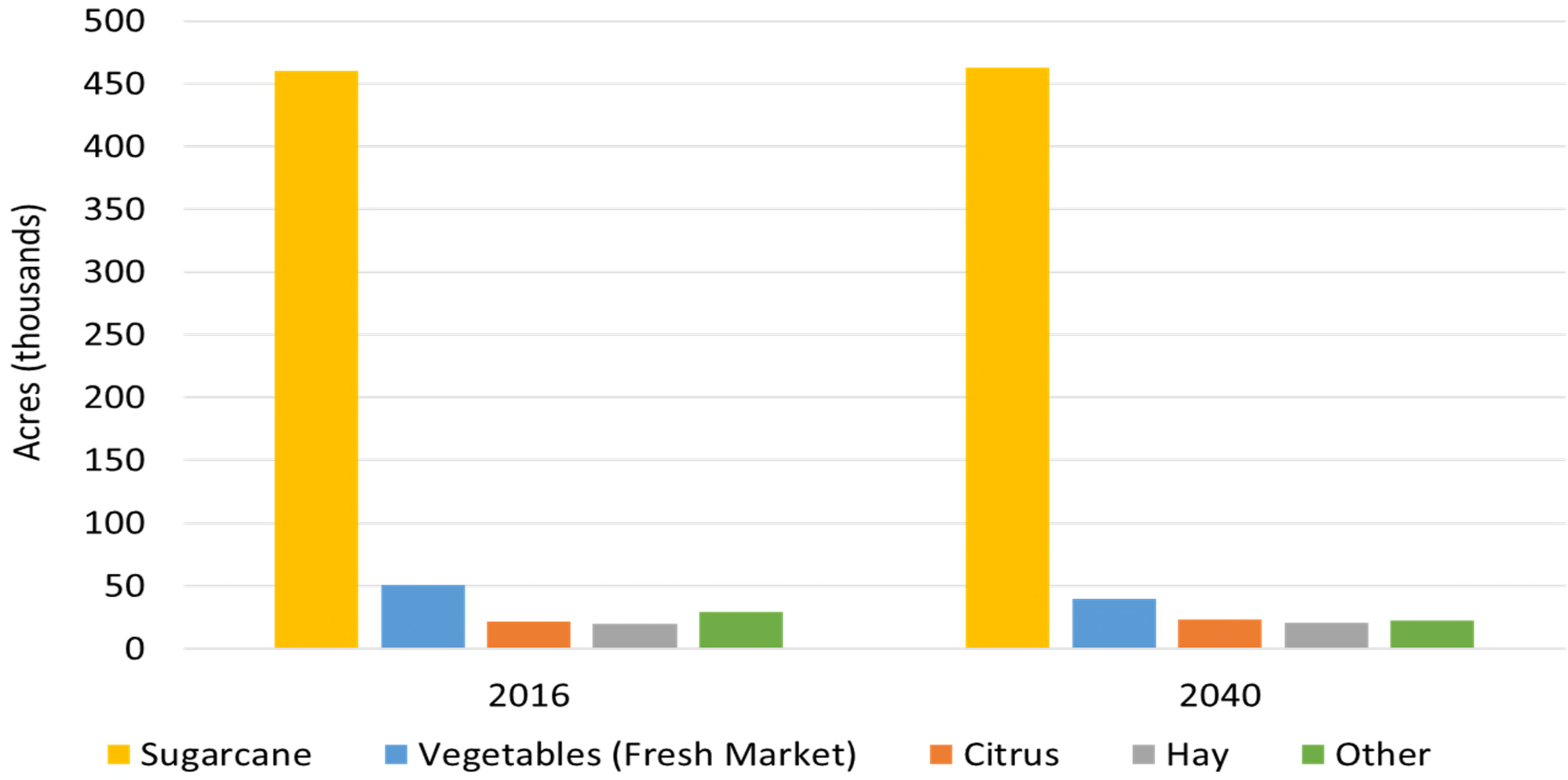


FSAID = Florida Statewide Agricultural Irrigation Demand

2016 FSAID Irrigated Areas



FSAID Irrigated Acreage in the LEC



Note: Sugarcane acres unadjusted from FSAID report

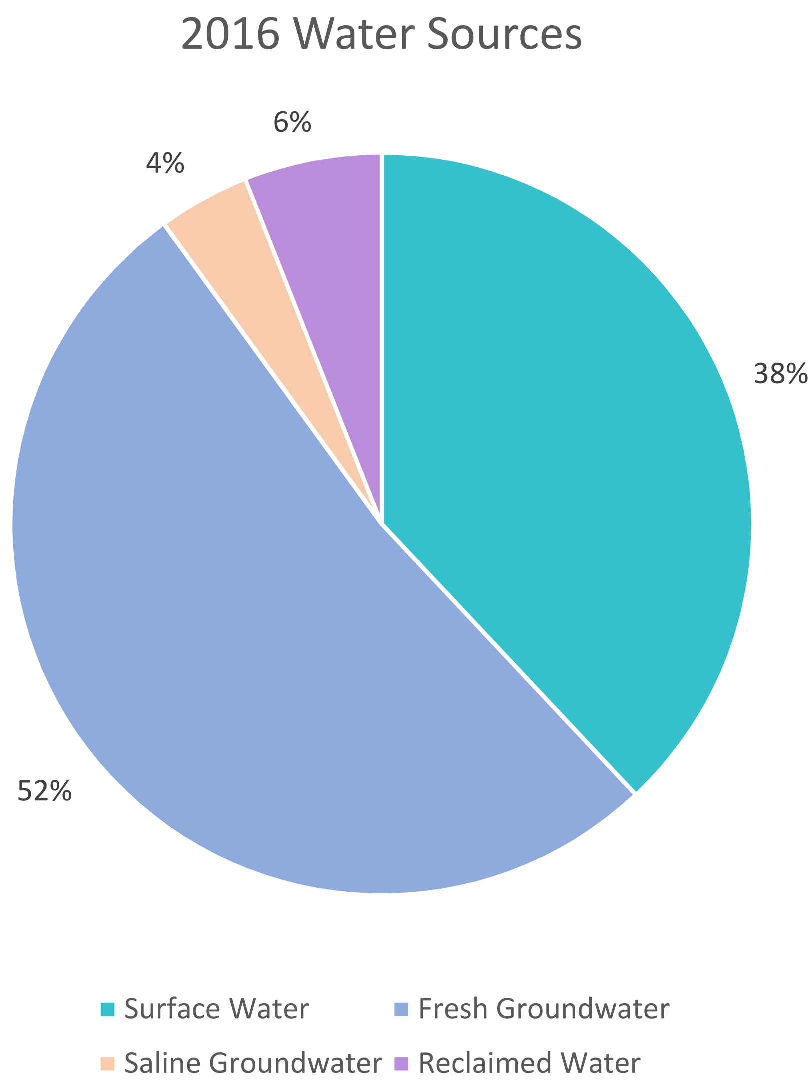
Agricultural Demand Summary

Crop Type	2016		2040	
	Acres	Average Demand (mgd)	Acres	Average Demand (mgd)
Sugarcane	460,260	486.62	444,362	472.75
Fresh Market Vegetables	50,804	50.58	39,798	36.22
Citrus	21,223	22.29	22,867	23.90
Other Crops*	49,183	93.01	43,053	75.52
Total	**581,470**	**652.50**	**550,080**	**608.39**

* Other crops includes sod, greenhouse/nursery, field crops, fruit (non-citrus), potatoes, pasture/hay.
mgd = million gallons per day.
Does not include aquaculture or livestock watering demands

Total Demand Projections

Water Use Category	2016 (mgd)	2040 (mgd)	Change (mgd)
Public Water Supply	864	1,088	+224
Domestic & Small Supply	12	16	+4
Agricultural Irrigation	653	625	-28
Recreational/ Landscape Irrigation	136	156	+20
Industrial/ Commercial/ Institutional	52	67	+15
Power Generation	40	53	+13
LEC Total	**1,757**	**2,005**	**+248**

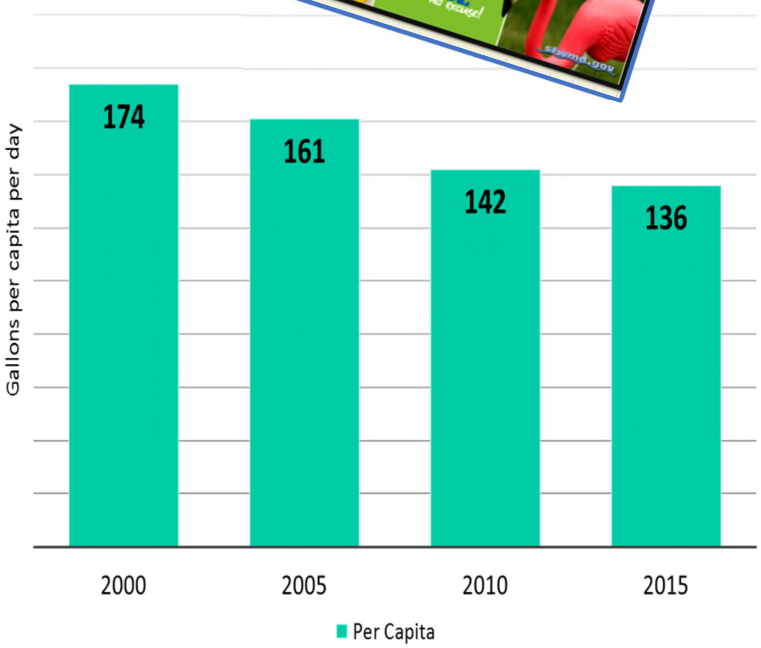


Demand Management: Water Conservation



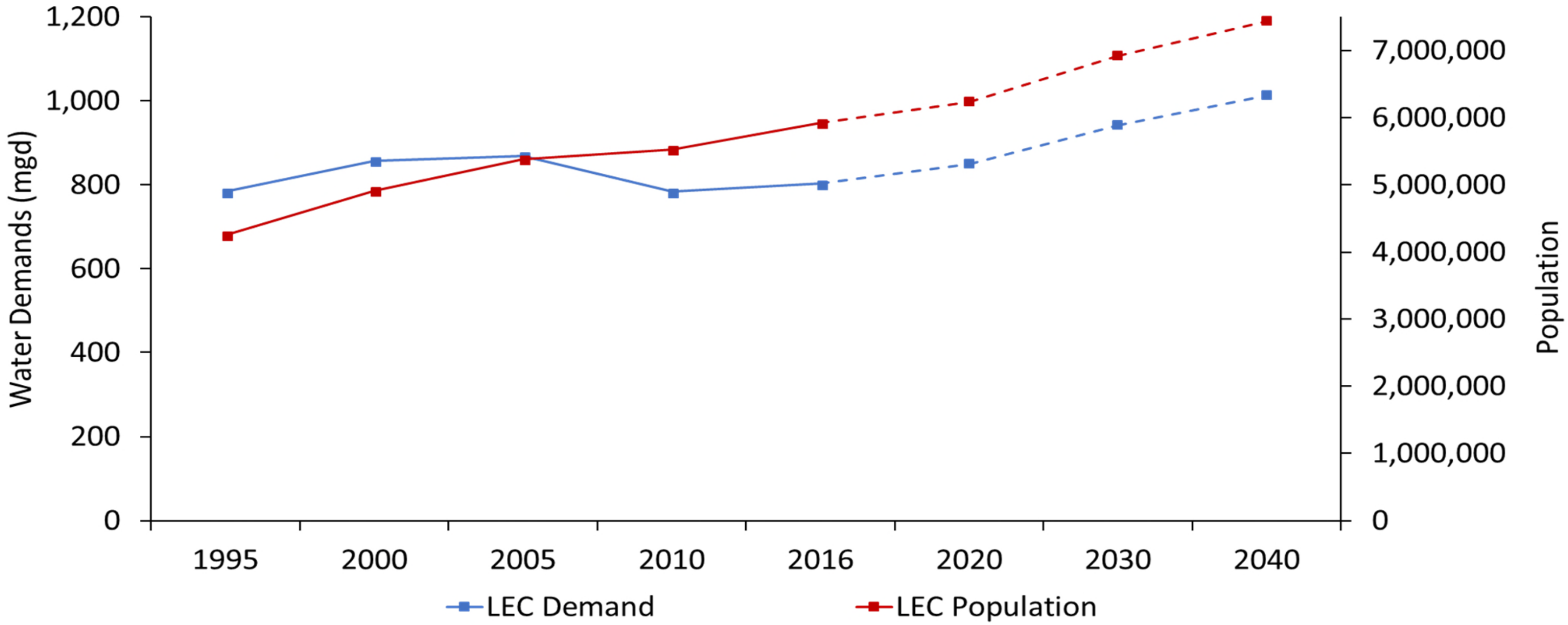
Among the lowest cost solutions

- Agriculture
  - FDACS Best Management Practices
  - More efficient irrigation systems
- Public Water Supply
  - Indoor and outdoor programs
  - Conservation rate structures
- 103 mgd potential savings through conservation
  - Urban – 79 mgd
  - Agriculture – 24 mgd



The cheapest gallon of water is the gallon we don't use

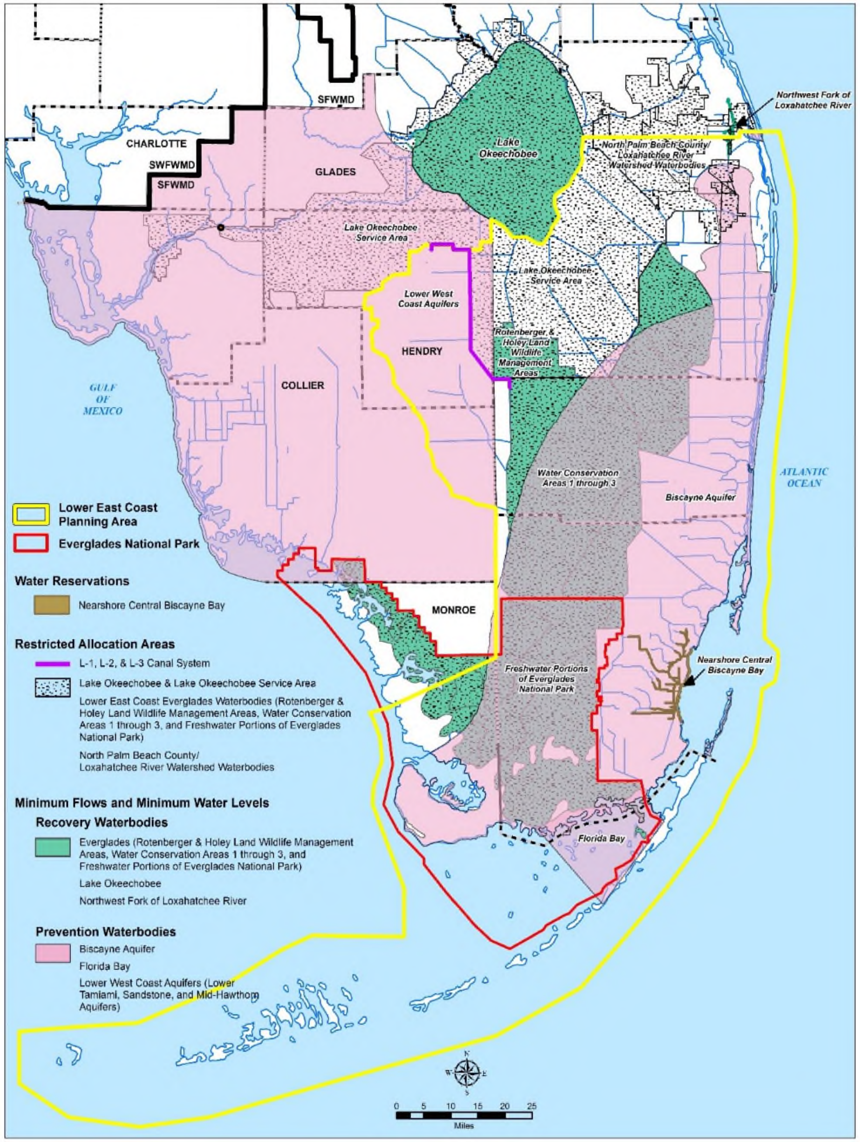
Population vs Demands





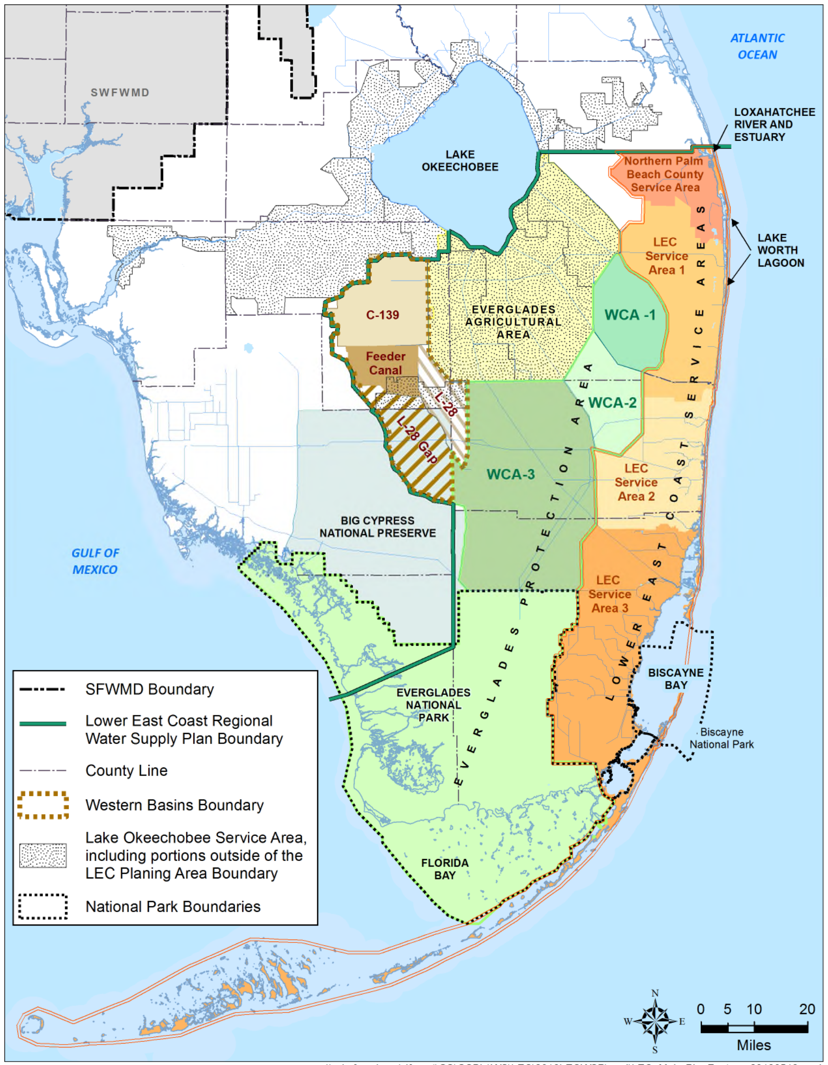
Water Resource Protections

- Water Reservations
  - Nearshore Central Biscayne Bay
- Minimum Flows and Minimum Water Levels
  - Lake Okeechobee
  - Everglades
  - Florida Bay
  - Biscayne Aquifer
  - Lower West Coast Aquifers
  - NW Fork Loxahatchee River
- Restricted Allocation Areas
  - Lake Okeechobee & LOSA
  - L-1, L-2 & L-3 Canal System
  - LEC Everglades Waterbodies
  - NPB County/Loxahatchee



Chapter 4, Appendix C

Surface Water Resources & Management



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- C&SF Project
  - Flood control
  - Water supply
  - Fish & wildlife preservation
  - Water supply & preservation of ENP
  - Saltwater intrusion prevention
  - Groundwater recharge
  - Recreation and navigation
- 4 sub-regions
  - Lake Okeechobee Service Area
  - Everglades Protection Area
  - Western Basins
  - Lower East Coast Service Areas

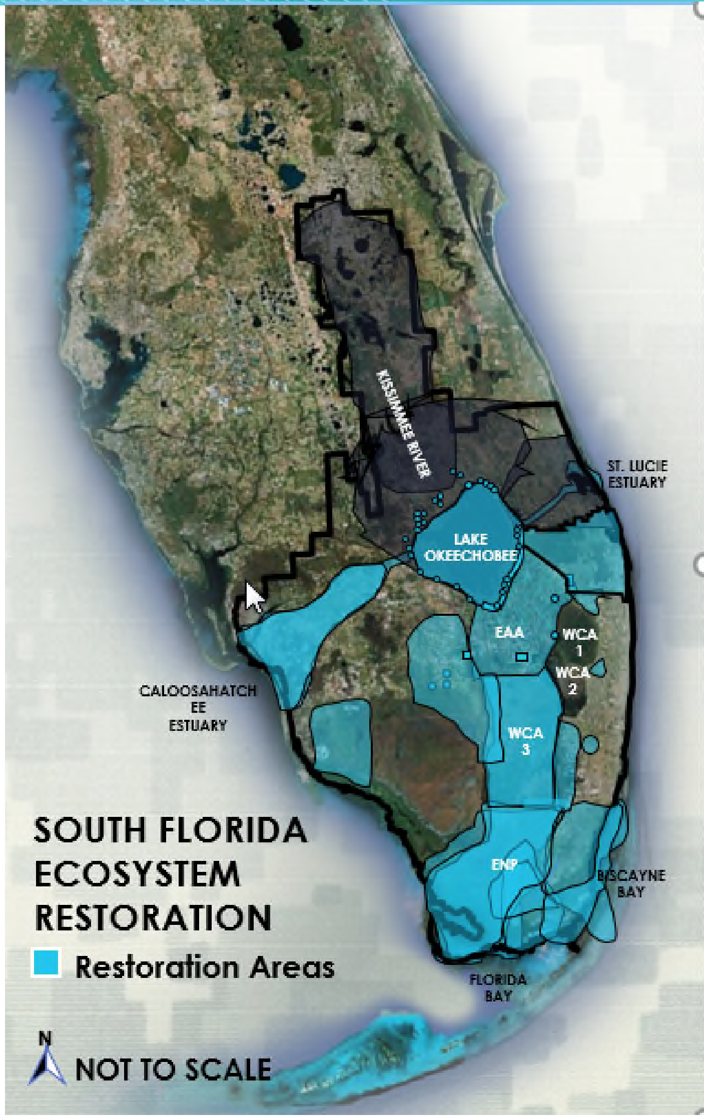
Water Resource Development



- Implementation of CERP and other projects*
- Hydrogeologic investigations
- Groundwater monitoring and modeling
- Alternative water supply and conservation programs
- Resource protection rule activities

* *MFL recovery and prevention strategies rely on CERP implementation.*

South Florida Ecosystem Restoration



INTEGRATED DELIVERY SCHEDULE

NON-CERP & FOUNDATION PROJECTS

- Modified Water Deliveries to Everglades National Park
- C-111 South Dade
- C-51/Storm Water Treatment Area (STA) 1E
- Restoration Strategies
- Tamiami Trail Bridging & Roadway Modifications
- Herbert Hoover Dike (HHD)Rehabilitation
- Seminole Big Cypress Critical Project

CERP GENERATION 1 PROJECTS

- Site 1 Impoundment
- Melaleuca Annex Facility

CERP GENERATION 2 PROJECT

- Broward County Water Preserve Areas (WPA)
- C-111 Spreader Canal Western Project
- Biscayne Bay Coastal Wetlands Phase I

DECEMBER 2016 AUTHORIZATION

- Central Everglades Planning Project (CEPP)

PLANNING EFFORTS

- Loxahatchee River Watershed Restoration
- Western Everglades Restoration
- Lake Okeechobee Watershed Restoration
- Everglades Agricultural Area Storage Reservoir

Water Supply Issues

- Limited opportunity to increase surface water and surficial aquifer use
  - MFLs and Restricted Allocation Areas for Everglades & Loxahatchee River
  - LOSA Restricted Allocation Area Rule
- Effects of climate change and sea level rise
- Environmental water needs
- Freshwater sources alone are inadequate to meet water needs through 2040
- Long-term sustainability of saline sources





Water Source Options

- Surface Water
- Reclaimed Water*
- Fresh Groundwater
- Reservoirs*
- Brackish Groundwater*
- Aquifer Storage & Recovery*
- Conservation*
- Seawater*

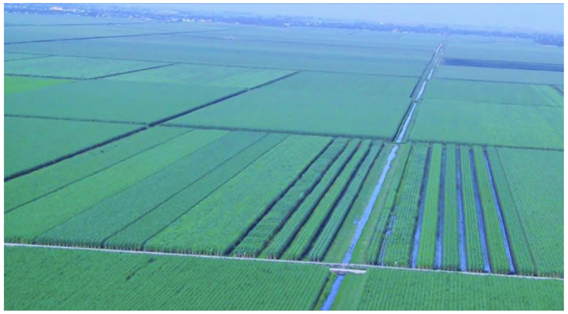
*** Alternative water source**

Water Source Uses

Category	Surface Water	Fresh Groundwater	Saline Groundwater	Reclaimed Water	Storage	Conservation
Public Supply	✓	✓	✓		✓	✓
Agricultural	✓	✓			✓	✓
Recreational/ Landscape	✓	✓	✓	✓		✓
Industrial/ Commercial/ Institutional	✓	✓		✓		✓
Power Generation	✓	✓	✓	✓		✓

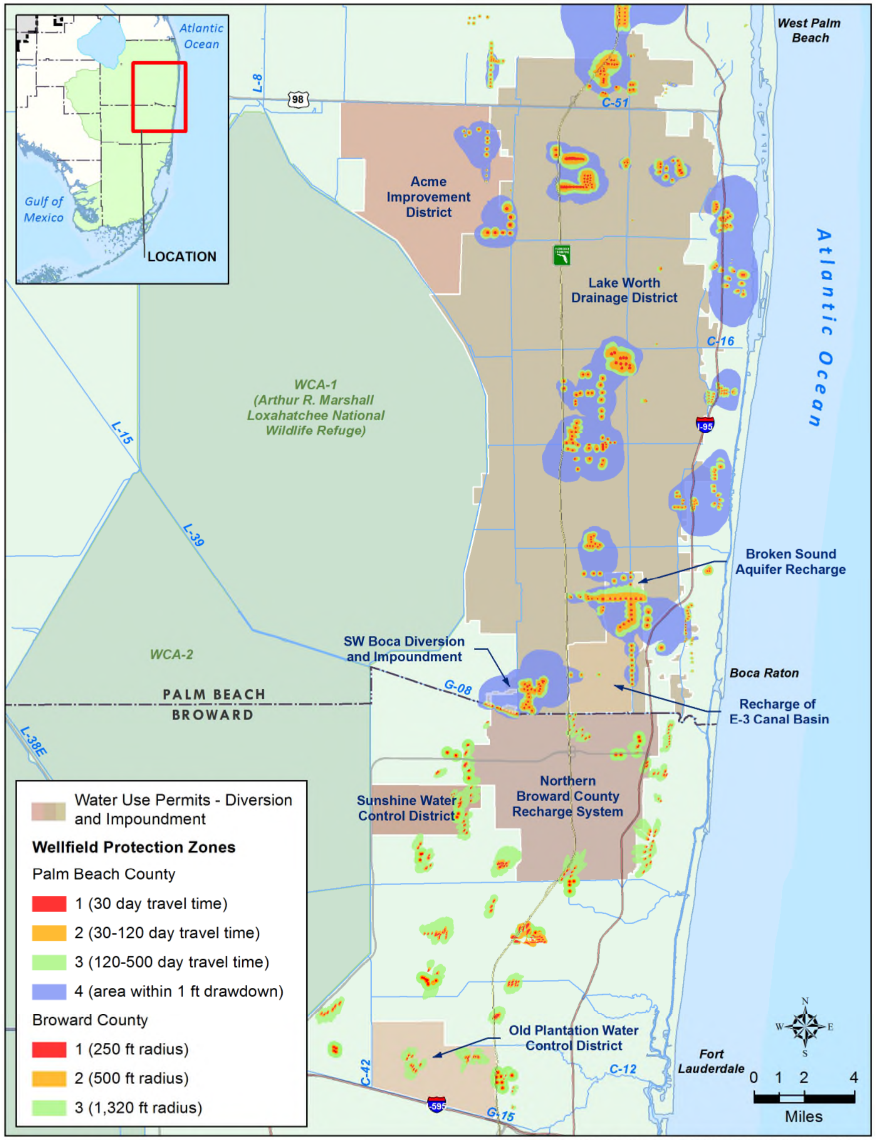






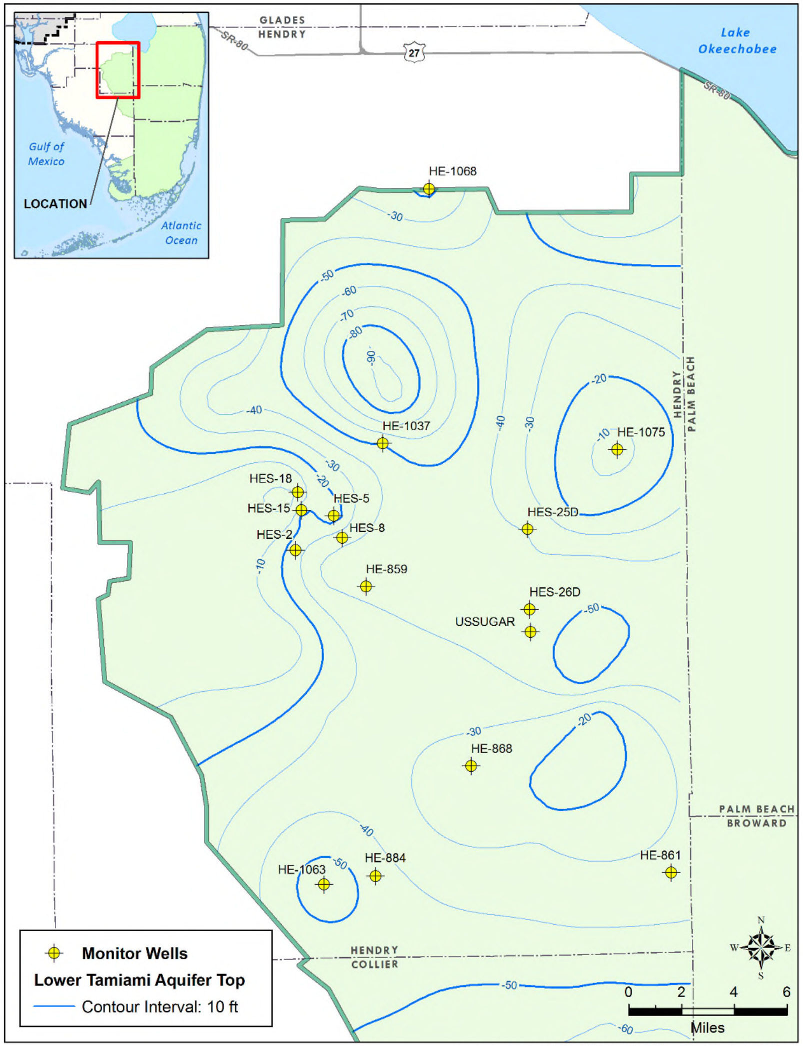
Surface Water Limitations

- Minimum flows and minimum water levels
  - Lake Okeechobee
  - Everglades
  - Loxahatchee River
  - Florida Bay
- Restricted Allocation Area
  - LOSA
  - LEC Regional Water Availability
  - L1, L2, L3 Canals
- Water Reservation for Biscayne Bay



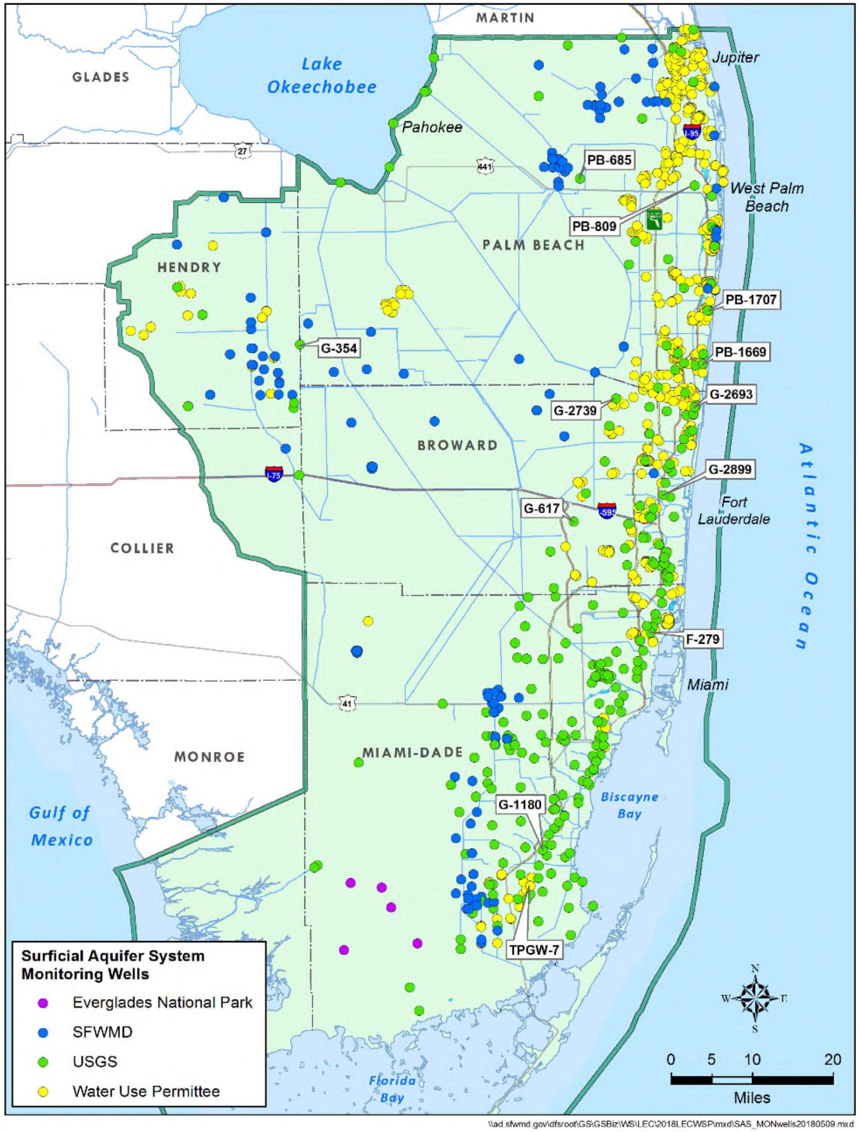
Fresh Groundwater Limitations

- Minimum flows & minimum water levels
  - Biscayne aquifer
  - Lower West Coast aquifers
- Restricted Allocation Area
  - LEC Regional Water Availability
  - LWC aquifers MDL
- Threat of saltwater intrusion
  - Coastal infiltration
  - Canal conduits from ocean
  - Upconing from relict seawater

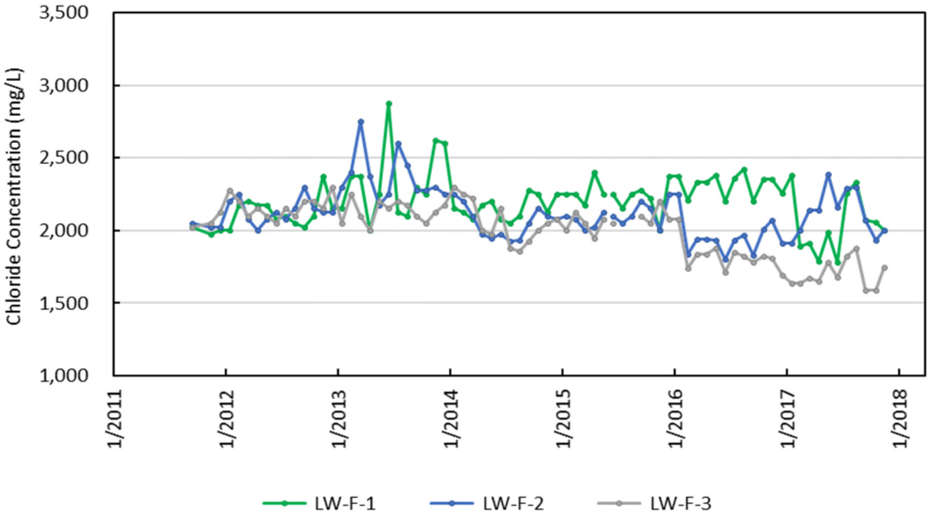


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Groundwater Monitoring

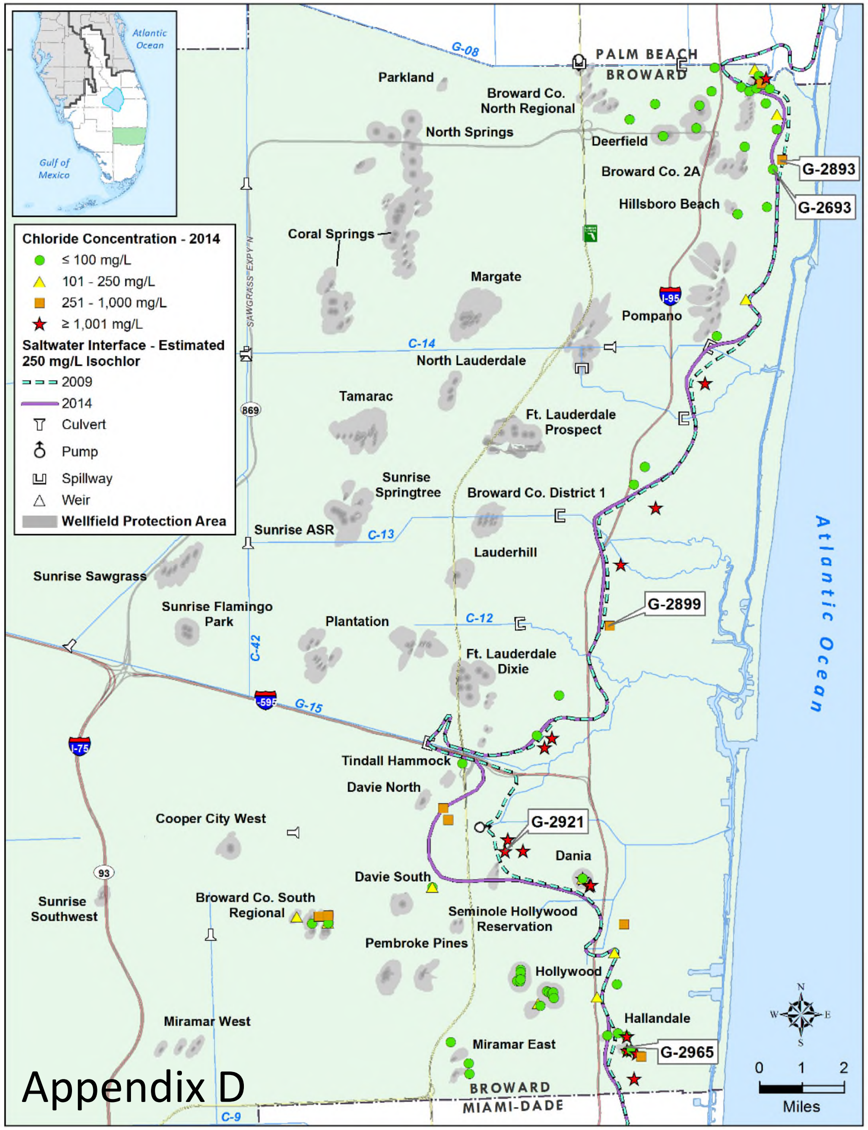


- Surficial aquifer system
  - Groundwater levels and salinities
  - Lower Tamiami MDL monitoring
- Floridan aquifer system
  - Regional water levels and salinities
  - Local wellfield operations



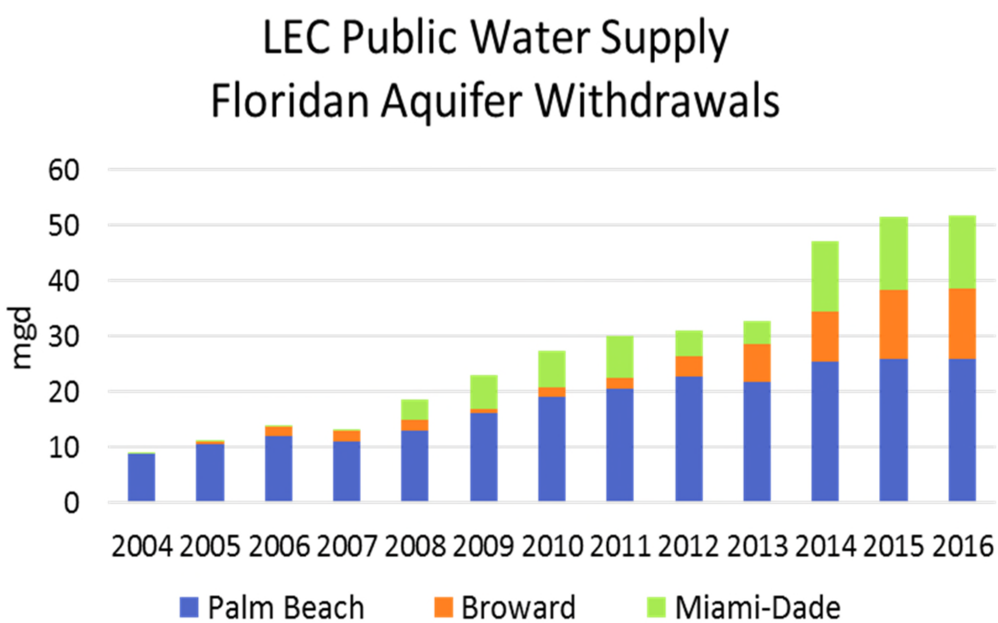
Appendix D

Saltwater Intrusion Information

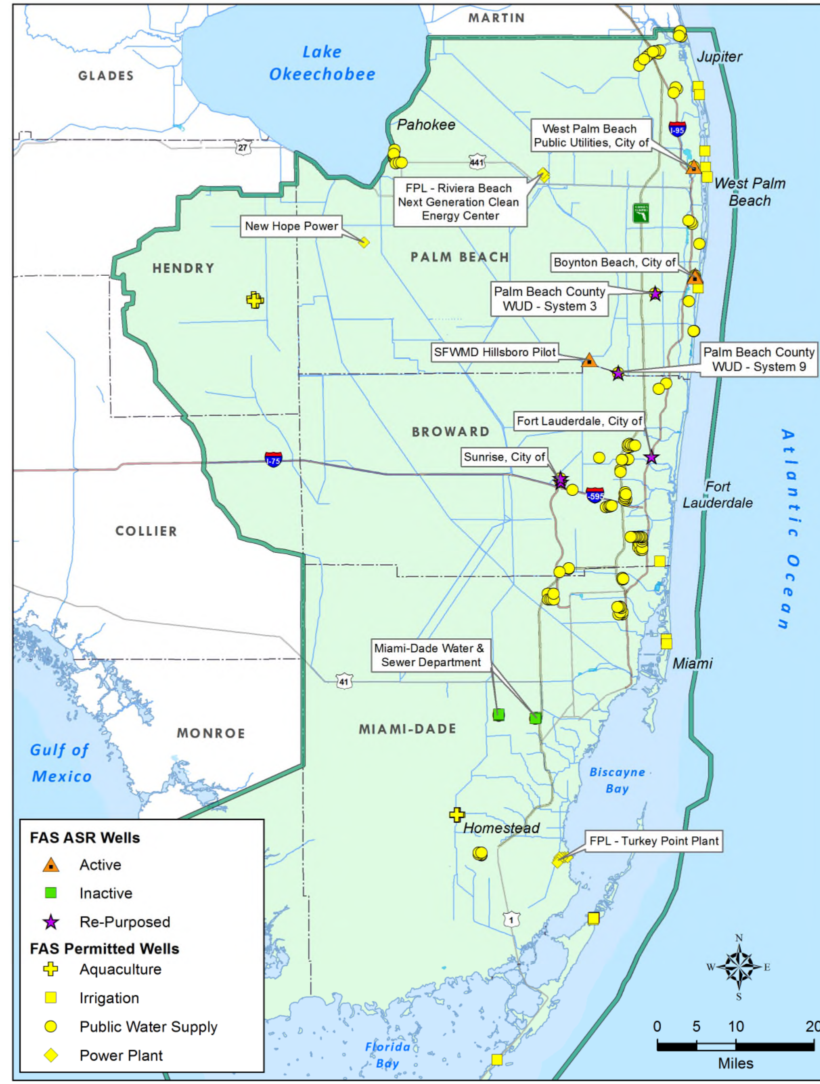


- Saltwater Interface Maps
  - Palm Beach & Broward updated in 2014 by SFWMD
  - Miami-Dade updated by USGS
- Chloride graphs and induction logs
- USGS County salt water intrusion models

Floridan Aquifer System Use

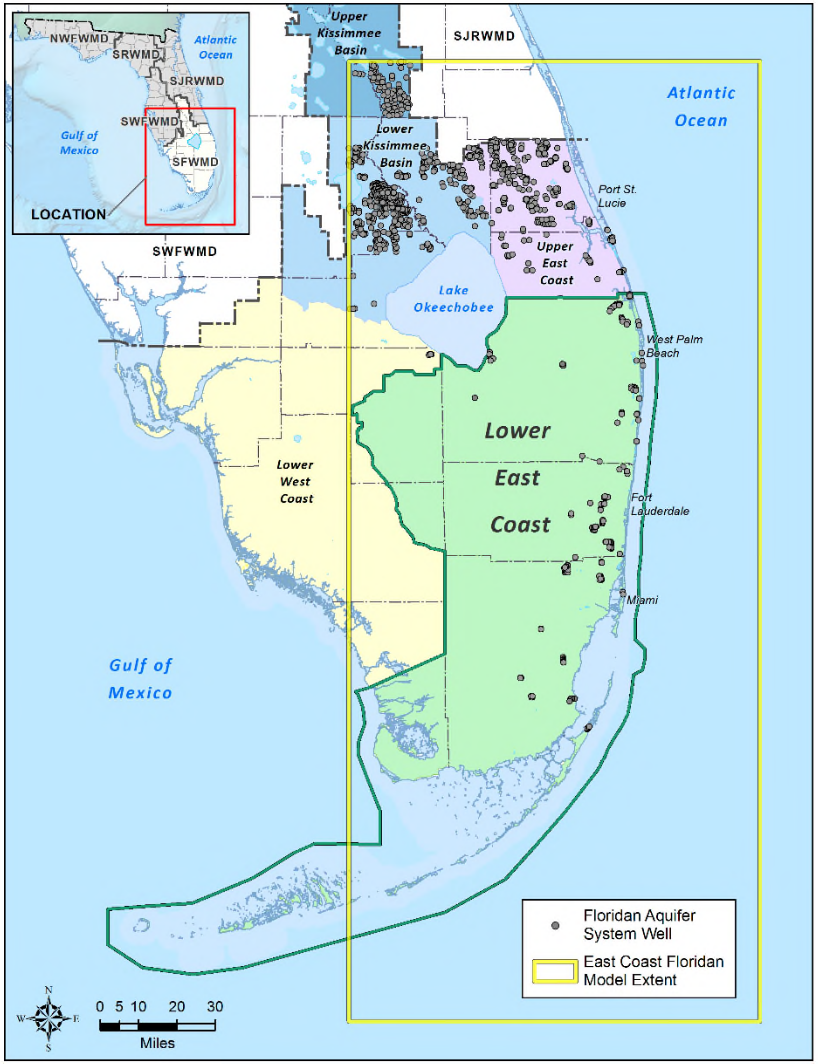


- 15 treatment facilities in 2016
- PWS FAS use could double by 2040
- Total FAS use may increase by 81 mgd by 2040 to 146 mgd



East Coast Floridan Model

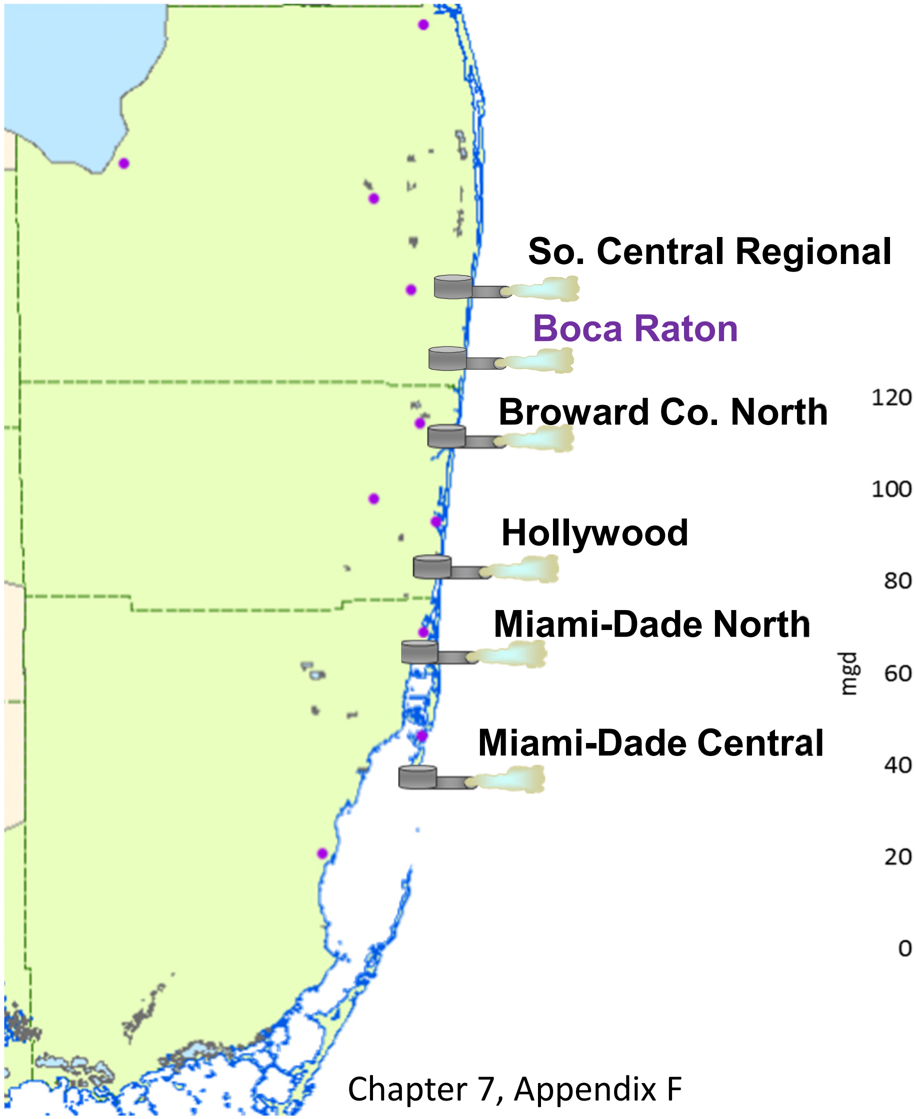
- New LEC Planning Tool
- 7-layer calibrated model
- Two major producing zones
- Floridan Aquifer System appears to be capable of meeting projected demands (146 mgd) for all users as simulated through 2040

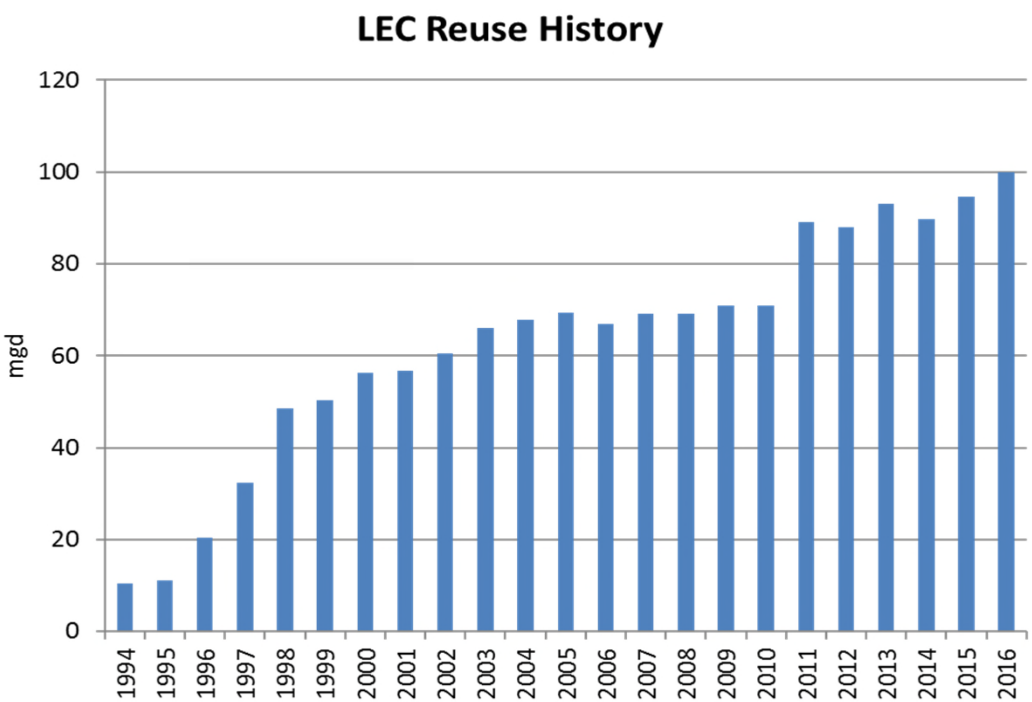


Appendix D

Reclaimed Water

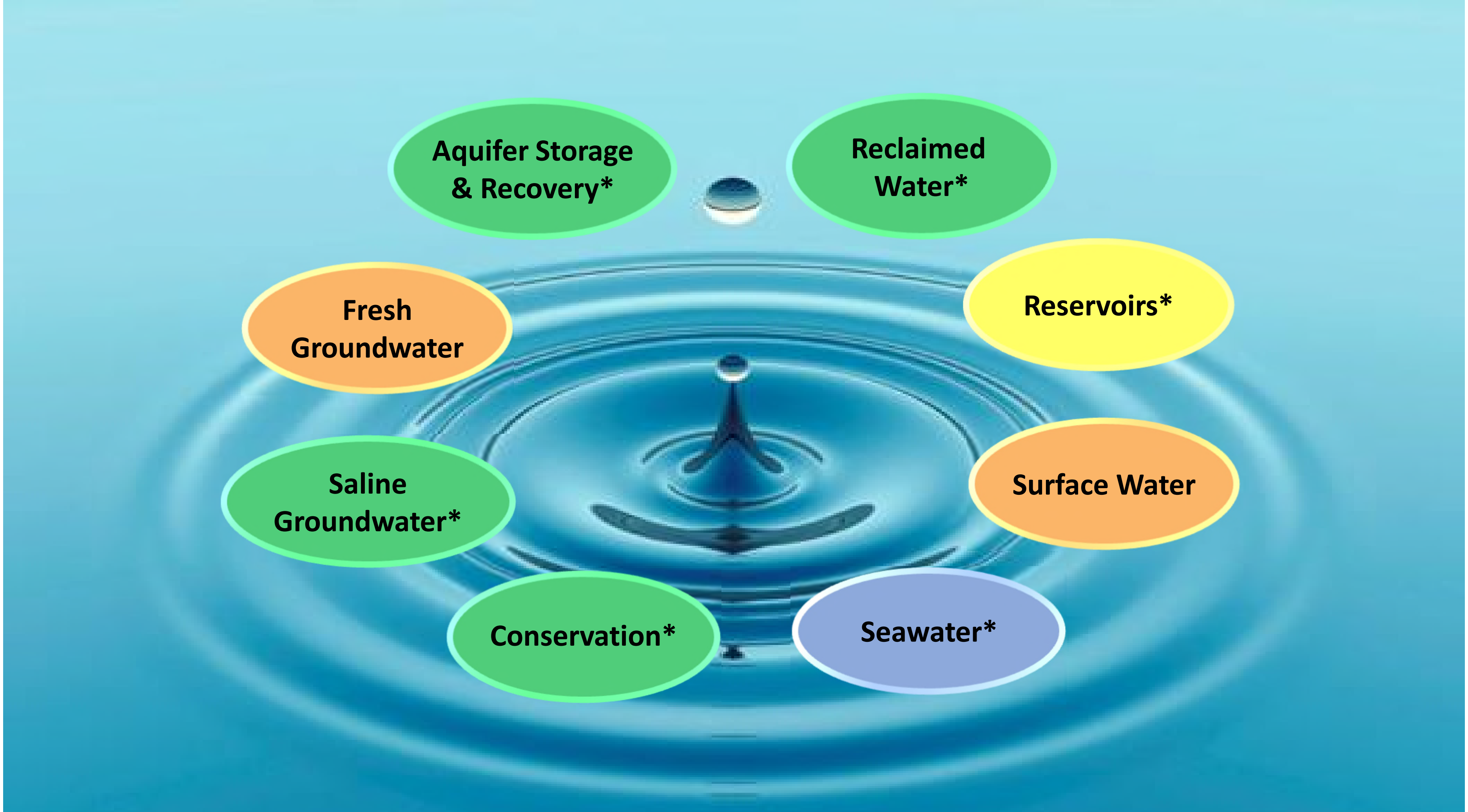
- 15% Reuse Rate
- Expansion expected





Chapter 7, Appendix F

Water Source Options



* Alternative water source

Water Supply Development



- Projects proposed by utilities
- Potable
  - Majority of utilities have sufficient capacity and permit allocations to meet 2040 demands
  - 17 utilities proposed projects
  - Only 9 out of 54 utilities need projects to meet 2040 demand projections or treatment requirements
- Nonpotable
  - 8 reclaimed water supply projects



Water Supply Project Summary

Source	Proposed Projects	Capacity (mgd)
Surface Water/Stormwater	5	40
Surficial Aquifer System	7	16
Floridan Aquifer System	17	63
Aquifer Storage and Recovery	1	6
Reclaimed Water*	8	177
Total	**38**	**302**

* Reclaimed water is not used as a potable water source in the LEC Planning Area, however it is an alternative water supply used to reduce reliance on traditional water sources.

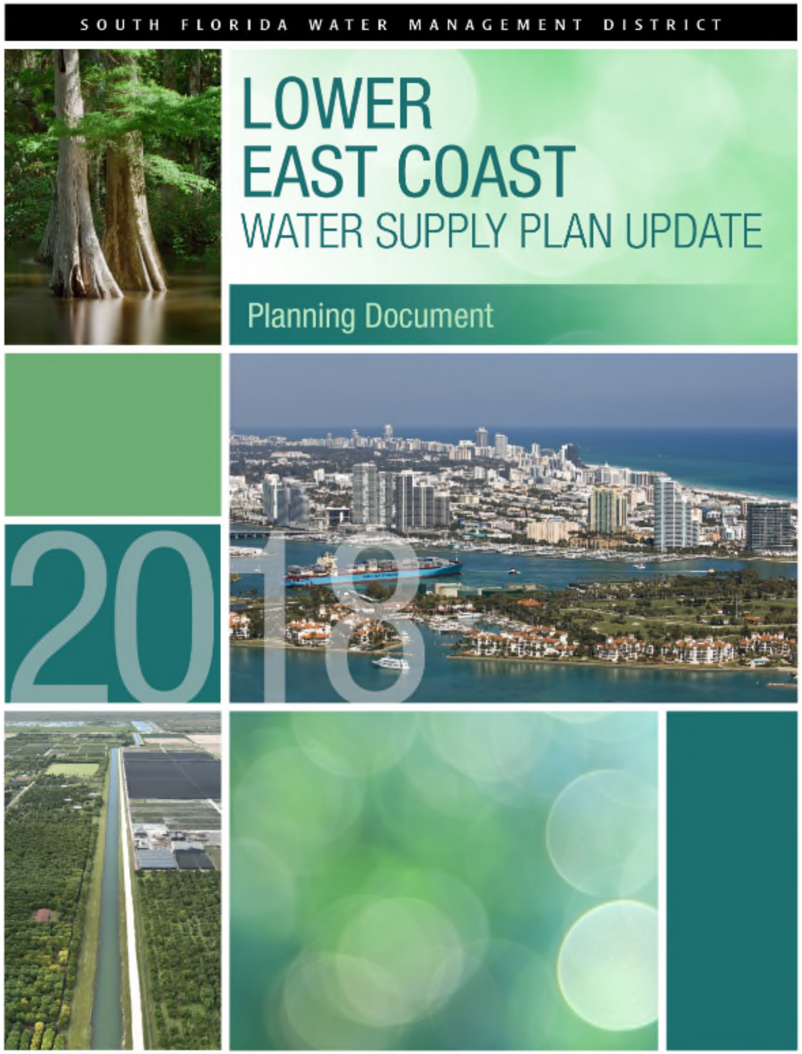
Future Direction



Loxahatchee Slough (Photo Credit: John Math)

- Continue implementation of:
  - MFL recovery and prevention strategies
  - robust water conservation programs
  - development of alternative water supplies
  - Comprehensive Everglades Restoration Plan (CERP) and other ecosystem restoration projects
- Continue to evaluate, monitor and design solutions in response to sea level rise and climate trends, participate in Climate Change Compact
- Implement long-term management measures of the Floridan aquifer system in coordination with Public Water Supply utilities
- Complete repairs to the Herbert Hoover Dike and reassess the 2008 LORS

Draft Plan Conclusion



The future water demands of the region during 1-in-10 year drought conditions can be met through the 2040 planning horizon with appropriate management, conservation, and implementation of projects in this 2018 LEC Plan Update

Depends on completion of:

- Identified CERP components and other projects to meet environmental needs
- Water supply development projects by utilities
- Completion of repairs to the Herbert Hoover Dike and implementation of a new Lake Okeechobee Regulation Schedule

HHD/LORS Update

Herbert Hoover Dike:

- With the addition of $100 million from the State of Florida, the federal Herbert Hoover Dike Rehabilitation Project is now fully funded
- Scheduled completion date for construction of dike repairs is 2022



Lake Okeechobee Regulation Schedule:

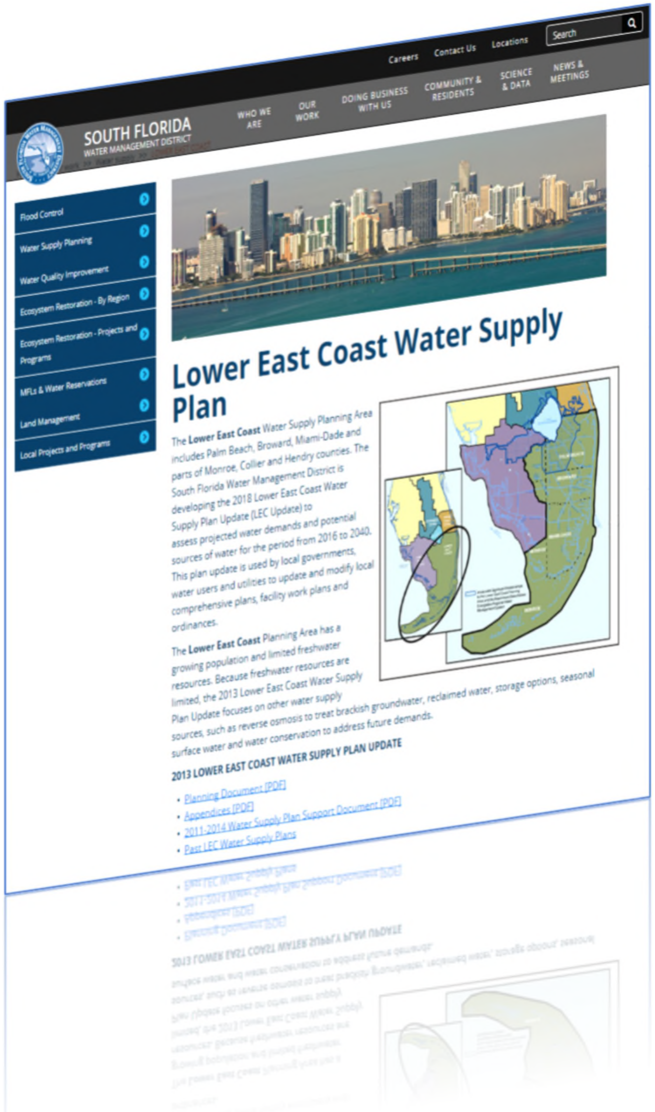
- U.S. Army Corps of Engineers is accelerating revisions to the Lake Okeechobee Regulation Schedule (LORS08) to sync with the completion of dike repairs
- U.S. Army Corps of Engineers anticipated schedule is to conduct formulation and evaluation of alternatives from January 2019 through September 2019 and finalize Record of Decision in September 2021
- Water Supply for water users and the environment are among the many performance measures to be evaluated in the Regulation Schedule revisions
- Future updates to the LEC Plan will reflect the outcome of the Regulation Schedule revisions

Next Steps

- *August 2* — *Overview of draft 2018 LEC plan presented at WRAC*
- *August 17* — *Draft plan posted for stakeholder review*
- **August 22** — Stakeholder meeting #3
- September 13 — Presentation of draft to Governing Board
- September 21 — Deadline for stakeholder written comments
- November 1 — Post final documents
- November 8 — Final plan to Governing Board for approval



Questions?



- Plan information can be found at: www.sfwmd.gov/lecplan
- Written comments to: Plan Manager – Karin Smith karsmith@sfwmd.gov

Thank You

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